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ABSTRACT

Designed and written for industrial arts instructors and students, this teacher-developed curriculum offers both a model for instructors and practical guidelines for classroom activities that explore the field of communications. Various aspects of course design and delivery are covered in the introductory section, including course goals and objectives, student outcomes, curriculum format, instructor guidelines for organizing and composing student modules, a bibliography, and achievement forms. The remaining units deal with the following topics: electricity/electronics (radio, telegraph, telephone, television); drafting (architecture, mechanical engineering, industrial engineering, civil engineering); photography (camera and lens, picture making with automatic cameras, camera construction and operation, types of black and white film, developing black and white film, making prints from negatives, photographic filters, photographic papers, making enlargements); graphic arts (block printing, rubber stamp construction, hot stamping, lithography/offset printing, silk-screen printing, posters, general safety). Each unit contains the following: unit objectives, performance objectives, content outlines, teacher activities, student activities, references, resources, information sheets, transparency masters, and tests and test answers. Also covered in each unit are occupations associated with the given area of communications. (MN)

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GENERAL INDUSTRIAL ARTS

Competency-Based Curriculum

in

COMMUNICATIONS

1796

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State Department of Education
Division of Vocational-Technical Education
Nashville, Tennessee 37219

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industrial arts
curriculum

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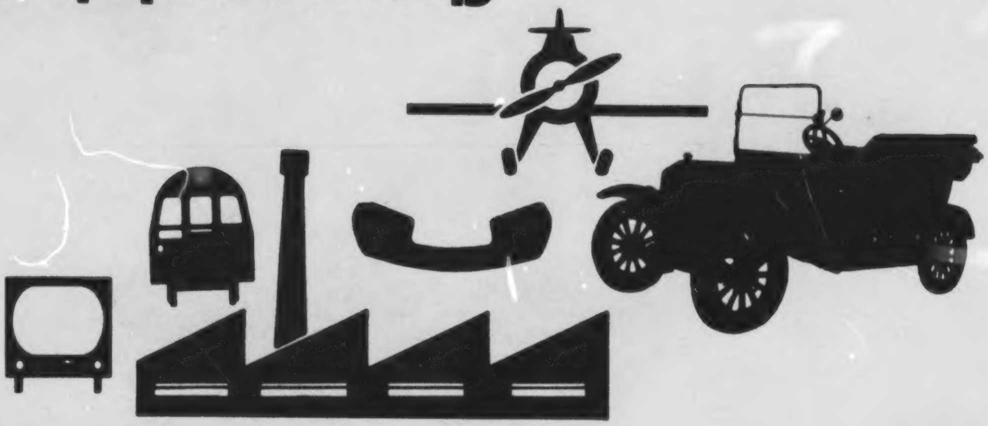

PREFACE: COMMUNICATIONS

Electrons create television pictures and artists paint masterpieces. This is the world of communications, a very large system of visual and audio images produced and received by our senses. Each method of communication is unique to what can be sent and received and involves different sources and uses of color and sound. This is an investigation into the man-made symbols we hear and see around us.

This curriculum has been designed and written for Industrial Arts instructors and students. It offers both a model for instruction and practical guidelines for classroom activities. It is a primer for exploration into the field of communications.

These materials are intended to be used by both the novice and veteran instructor. Special attention has been given to format and content, compensating for differences in the instructor's previous knowledge and experience. Loose-leaf pages permit immediate revision and expansion so that instructors and students will find the materials easy and enjoyable to use.

Industrial Arts instructors in Tennessee developed this curriculum in three stages. First, a state-of-the-art study was conducted to determine what had been published in communications curricula. Second, practiced instructors wrote the materials. Finally, students and instructors used the curriculum in their classrooms before it was revised and published. All of this required fourteen months, from research, writing and field testing, through revision.

On behalf of these instructors we hope that you will join us as we view and listen to the communications world. But this is only the beginning. We request your comments and contributions as a means of continually shaping and coloring this curriculum.

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INTRODUCTION: COMMUNICATIONS

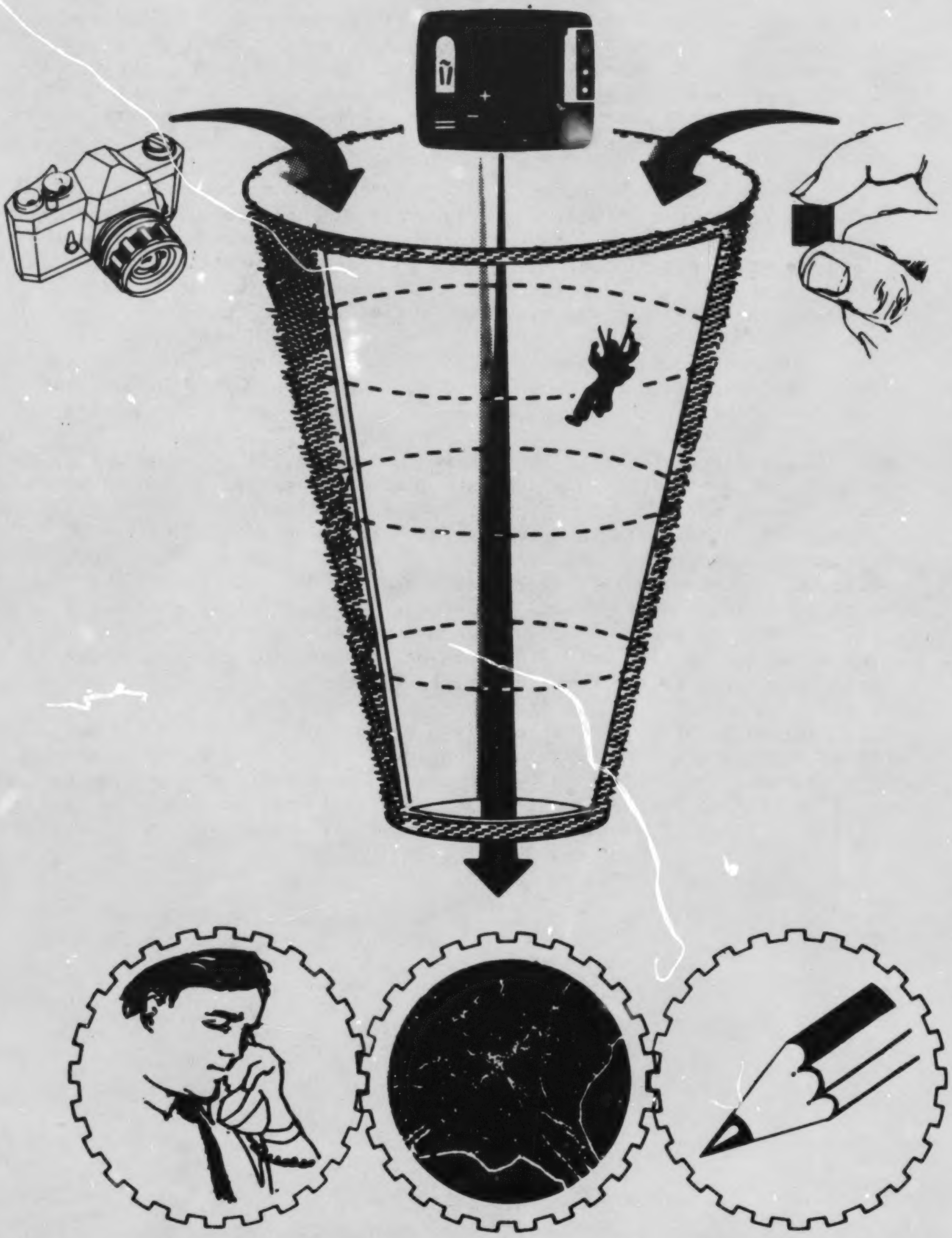
This program is designed to assist individuals in the making of informed and meaningful occupational choices. In the exploration of the world of communications students will develop an awareness of the industry and technology and the changes it brings to an evolving society. Application of the program will help students develop the technical competencies, concepts and basic skills which are common to the industrial-technical materials and processes of the communications industry.

The content of the curriculum is structured analogous to an inverted cone. Starting at the top it offers a broad, circular panorama, an overview of the world of communications. As the curriculum telescopes downward to the tip of the cone, the specific details and components--the subject matter--come into perspective. In addition the cone can be imagined as surrounded or enclosed in a netting or mesh--the functions and duties of the jobs in the field of communication. As students traverse this cone, both across and through its diminishing diameters, their exploration becomes focused and the discoveries they make can be carried through the point of departure. The student leaves with the elementary knowledge and skills of the "cone" of communications.

The subject matter is the curriculum: shape, weight and density to the general concept. It is divided into four major means of communication which exist in the world today. Each of these avenues of communications is presented and investigated in the manner described in the preceding paragraph. The medium of photography, for example, carries a visual message. The students are oriented to this concept before they take and develop their first picture. The students must create a visual image of a building before they learn to represent it on paper. The subject matter in each of the four sections is contained in a packet of units, each unit generating momentum which is applied and transferred to the next in the cluster.

The world of communications is a product of a creative industry, one which began with ideas. The curriculum explores the processes, tools and materials that allowed these ideas to become usable products. It is hoped that students will be able to develop the insight, understanding, and practical skills from different types of communication so that their own ideas can be created.

C 2



PROGRAM GOALS AND OBJECTIVES: COMMUNICATIONS

DEFINITION

Industrial Arts Education is that segment of the total educational program that is conceived and designed to interpret, humanize and make meaningful to all students the basic functions and concepts of industry and technology through a broad spectrum of experiences and activities with the materials, processes, and related problems of our industrial-technological society.

GOALS

To provide students with a variety of laboratory and classroom experiences with emphasis upon the orientation and exploration of the occupational cluster of communications.

To acquaint students with the principles of various visual communication techniques and devices used in our present technological society.

To allow for exploration in specialized and allied fields of visual communication technology in order to develop an awareness of the existing occupational and educational opportunities.

OBJECTIVES

Develop an insight and understanding of industry, its place in our society, and the free enterprise system;

Discover and develop individual talents, aptitudes, interests, and potentials as related to industry and technology;

Develop an understanding of industrial processes and the practical application of scientific principles;

Develop basic skills in the proper use of common industrial tools, materials, and processes;

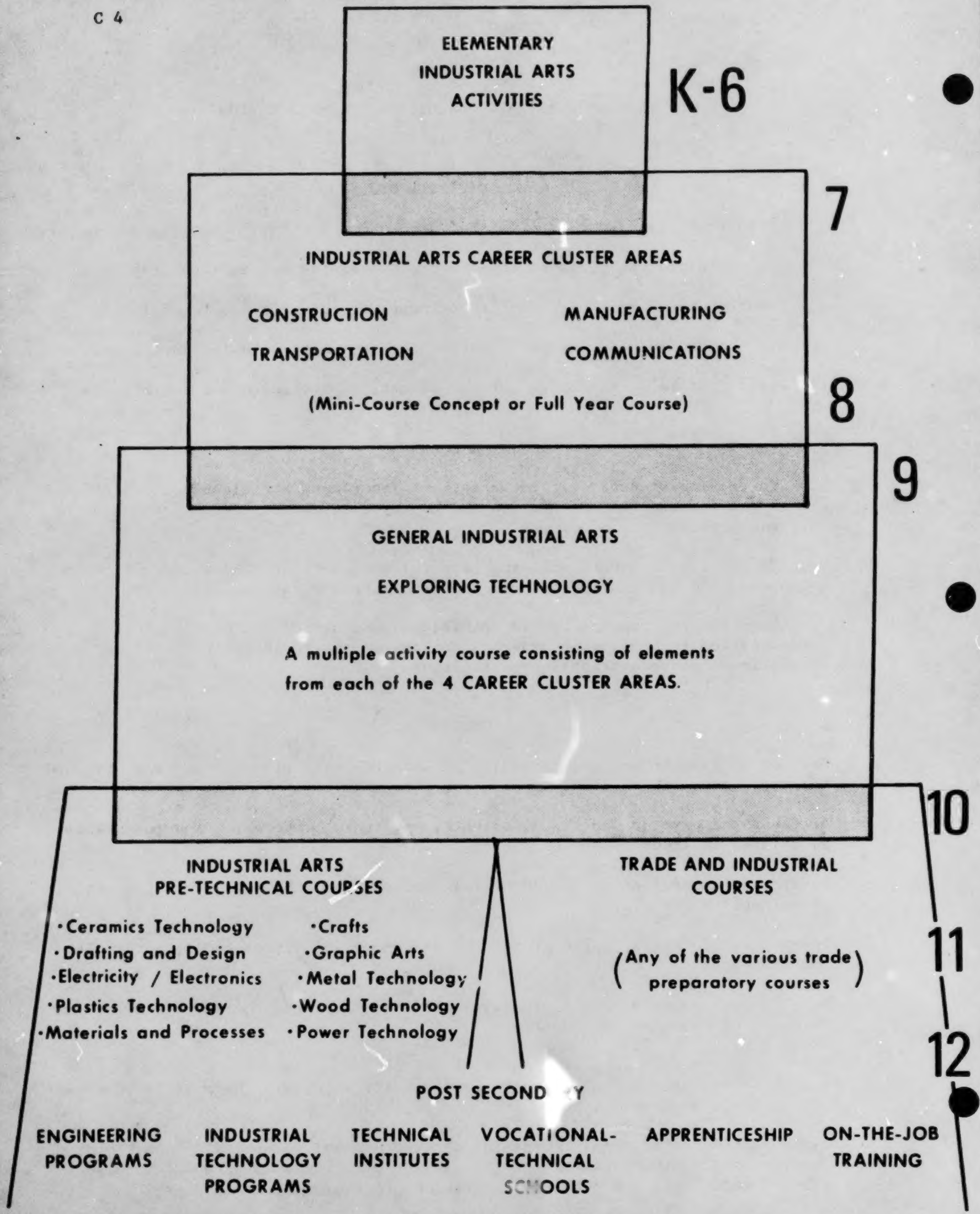
Develop problem-solving and creative abilities involving the materials, processes, and products of industry;

Develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment.

Assist individuals in (a) the making of informed and meaningful occupational choices and (b) in preparing individuals for enrollment in advanced or highly skilled vocational and technical education programs.

C 4

SCOPE AND SEQUENCE



ELEMENTARY
INDUSTRIAL ARTS
ACTIVITIES

K-6

7

INDUSTRIAL ARTS CAREER CLUSTER AREAS

CONSTRUCTION
MANUFACTURING
TRANSPORTATION
COMMUNICATIONS

(Mini-Course Concept or Full Year Course)

8

9

GENERAL INDUSTRIAL ARTS

EXPLORING TECHNOLOGY

A multiple activity course consisting of elements from each of the 4 CAREER CLUSTER AREAS.

10

INDUSTRIAL ARTS
PRE-TECHNICAL COURSES

- Ceramics Technology
- Drafting and Design
- Electricity / Electronics
- Plastics Technology
- Materials and Processes
- Crafts
- Graphic Arts
- Metal Technology
- Wood Technology
- Power Technology

TRADE AND INDUSTRIAL
COURSES

(Any of the various trade preparatory courses)

11

12

POST SECONDARY

ENGINEERING PROGRAMS

INDUSTRIAL TECHNOLOGY PROGRAMS

TECHNICAL INSTITUTES

VOCATIONAL-TECHNICAL SCHOOLS

APPRENTICESHIP

ON-THE-JOB TRAINING

STUDENT OUTCOMES

This curriculum has been written to bridge the gap between elementary school career education activities and high-school-level vocational education courses. It is one of four major career cluster curricula intended for use in Industrial Arts in the middle or junior high school (grades seven through ten). It provides career exploration and basic skill development through the multiple-activity approach of general Industrial Arts.

Industrial Arts programs are not intended to prepare students for employment in specific occupations. The emphasis is placed on short-term manipulative and exploratory experiences leading to an understanding of modern industry, its tools, processes and materials. Activities are designed to develop the students' awareness and interest in the many occupational possibilities open to them. The final outcome should allow individuals to make informed and meaningful occupational, consumer, and avocational choices.

But the transition from awareness and investigation to decision and choice requires articulation. The general nature of Industrial Arts and its position in the educational continuum should be followed by more specific occupational programs. This curriculum has been designed, in part, for student matriculation into trade and industrial and pre-technical courses and into various types of postsecondary training. This articulation can only be achieved if these options are available to students.

This curriculum is one of four tiers comprising the general Industrial Arts matrix shown on the following page. The purpose of this matrix is to illustrate the grade and career cluster relationship of Industrial Arts in Tennessee. Instructors are encouraged to block, by subject area, the time they spend teaching these curricula in the classroom. A mini-course schedule can be utilized in grades 7 and 8 ranging from 6 to 12 weeks. A complete course of study of 18 or 36 weeks is more suited for grades 9 to 10. Credit should be granted proportionally from 1/2 unit through 2 units for a one-year course. This matrix, appropriately completed, can be an aid to scheduling and to diagramming internal Industrial Arts articulation.

Every unit or module in this curriculum lists performance objectives or proficiency levels. These objectives were developed from the job duties detailed in the job structure and adopted to the philosophy of Industrial Arts. Student performance is therefore not geared towards employment competencies. The objectives do describe the tasks to be performed, the conditions under which they will be performed, and the standard of acceptable performance.

This curriculum provides pre-occupational exploratory experiences for students, leading not only to advanced vocational-technical education studies, but contributing to the students' avocational activities and consumer knowledge. The course map that follows is a graphic representation depicting the students' entrance and exit through this program.

ARTICULATION MATRIX

	Construction	Manufacturing	Transportation	Communications	
Grade 7 (1st year)					36 weeks (180 hours)
Grade 8 (2nd year)					36 weeks (180 hours)
Grade 9 (3rd year)					36 weeks (180 hours)
Grade 10 (4th year)					36 weeks (180 hours)

CURRICULUM FORMAT

There are four major sections in the Industrial Arts--Communications curriculum. Each section is divided into units of instruction. (See the Course Map).

Electricity and Electronics (EE)
Drafting and Design (DD)
Photography (PH)
Graphic Arts (GA)

The order in which these sections are presented is at the discretion of the individual instructor . The sections can be taught as they are or used in conjunction with the instructor's own instructional materials.

This curriculum has been designed for one year or 180 hours of instruction. Each section can be used on a 9 or 12 week basis.

Each unit of instruction is divided into the following parts:

Description of Unit
Unit Objective
Performance Objectives
Outline of Content
Teacher Activities
Student Activities
References/Resources
Information Sheets
Transparency Masters
Teacher Demonstration Sheets
Student Assignment Sheets
Student Activity Sheets
Unit Test(s)
Answers to Test(s)
Equipment/Supplies

Following each section in the curriculum is a comprehensive Job Structure (JS). This can be used when instructing from the Outline of Content or performing Activities.

Every unit has a self-contained numbering system, and each unit begins with page number one. The pages are numbered consecutively except for the Transparency Masters, which are numbered separately in upper right hand corner.

The objectives listed at the begining of each unit are measured either by a student assignment, by a student activity, or by a test. Answers are provided for all of the assignments and tests. The minimum acceptable performance levels for assignments, activities and tests are to be determined by the instructor. Also, the point or grade values for these evaluation instruments are to be established by the instructor.

C 8

The Individual Student Achievement Records and the Class Competency/Progress Record should be separated from this introductory section and reproduced for use in the classroom.

The Division of Vocational-Technical Education would appreciate your your evaluations and comments as you utilize this curriculum for Industrial Arts--Communications.

Industrial Arts
212 Cordell Hull Building
Nashville, Tennessee 37219

COURSE MAP: COMMUNICATIONS

Electricity and Electronics

1. Introduction
2. Electricity
3. Electronics
4. Radio
5. Telegraph
6. Telephone
7. Television

Drafting and Design

1. Architecture
2. Mechanical Engineering
3. Industrial Engineering
4. Civil Engineering
5. Other Engineering Specialties

Photography

1. Camera and Lens: Types of Uses
2. Picture Making with Automatic Cameras
3. Camera Construction and Operation
4. Types of Black and White Film
5. Developing Black and White Film
6. Making Prints from Negatives
7. Photographic Filters
8. Photographic Papers
9. Making Enlargements
10. Photographic Activities

Graphic Arts

1. Introduction
2. Block Printing
3. Rubber Stamp Constructio
4. Hot Stamping
5. Lithography/Offset Printing
6. Silk-Screen Printing
7. Posters
8. General Safety

INSTRUCTORS'S GUIDELINE FOR ORGANIZING AND COMPOSING STUDENT MODULES.

The Instructor's Guide for this curriculum contains all of the materials needed to form a Student Module. Extract, duplicate, collate and staple from each unit the pages listed below.

Discription of Unit
Unit Objective
Performance Objective
Student Activities
References/Resources (optional)
Information Sheet
Assignment Sheet
Student Activity Sheets
Unit Test(s)

Pre-Test/Post-Test *
Job Structure *

* These items follow each section in the curriculum. They may be reproduced and distributed separate from individual units.

SUGGESTED PAPER COLOR CODE FOR REPRODUCING STUDENT MODULES

White

Unit Objective
Description of Unit
Performance Objective
Outline of Content
Teacher Activities
Student Activities
References/Resources
Transparency Masters

Green

Information Sheets

Buff

Demonstration Sheets

Brown

Assignment Sheets
Student Activity Sheets

Yellow (canary)

Test(s)

Pink

Answers to Test(s)

Cherry

Equipment/Supplies

Blue

Job Sheets

C 12

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Stenographer

Emma Neal
Stenographer

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Powell

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Dyersburg

Don Houston
Union City

Roger Jackson
Knoxville

Charles Jewell
Old Hickory

Charles Littleton
Memphis

Robert Long
Memphis

Joseph Stophel
Bluff City

William Suggs
Memphis

Robert Wolle
Brighton

James Yadon
Germantown

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Greeneville

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University of Tennessee
Knoxville

Dennis Hirsch
Cordell Hull Building
Nashville

Guy Kirk
Huntingdon

Edward Mann
Memphis State University
Memphis

Bob Parsons
Cordell Hull Building
Nashville

Darrell Simmons
Walters State Community College
Morristown

Harry Smith
Tennessee Technological
University
Cookeville

I. G. Smith
Davidson Co. Board of Education
Nashville

Hubert Stuckey
Georgetown

C 14

FIELD TEST PARTICIPANTS

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Oak Ridge

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Goodlettsville High School
Goodlettsville

Robert A. Crutcher
Goodlettsville High School
Goodlettsville

Johnny Davis
Chattanooga High School
Chattanooga

Ralph Ford
Parkway Jr. High School
Jackson

Dale Grissom
Upperman High
Baxter

Joseph Hicks
Boones Creek Middle School
Jonesboro

Robert Johnson
Tyner Junior High
Chattanooga

Thomas LaFlora
Raleigh Egypt High
Memphis

David Lea
Central High School
Columbia

Scott Leech
Dalewood Junior High
Chattanooga

William E. Locke
Fayetteville Jr. High
Fayetteville

Rex Miller
Greenville Middle School
Greenville

Gerald S. Pryor
Cookeville Junior High
Cookeville

Charles Rice
Hardin County Jr. High School
Savannah

Ferrell W. Robinson
Neely's Bend Junior High
Madison

Don Sadler
Algood Junior High
Algood

Robert Swartz
Lamar School
Jonesboro

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NOTE: All of the citations listed above are on file at the Tennessee State Department of Education Media Center, Smyrna, Tennessee. This bibliography does not include all of the references contained in this curriculum.

STUDENT ACHIEVEMENT RECORD

Student's Name ____________________
Instructor's Name ____________________

Grade Level ____________________
Name of School ____________________

SECTION ELECTRICITY/ELECTRONICS
Pre-Test ______________
Post-Test ______________

UNITS	STUDENT ASSIGNMENTS/ACTIVITIES																						UNIT TEST			FINAL GRADE
1. Introduction																										
2. Electricity																										
3. Electronics																										
4. Radio																										
5. Telegraph																										
6. Telephone																										
7. Television																										

STUDENT ACHIEVEMENT RECORD

Student's Name ____________________ Instructor's Name ____________________

Grade Level ____________________ Name of School ____________________

SECTION DRAFTING/DESIGN Pre-Test ______________ Post-Test ______________

UNITS	STUDENT ASSIGNMENTS/ACTIVITIES																						UNIT TEST			FINAL GRADE
1. Architecture																										
2. Mechanical Engineering																										
3. Industrial Engineering																										
4. Civil Engineering																										
5. Other Engineering Specialities																										

STUDENT ACHIEVEMENT RECORD

Student's Name ____________________ Instructor's Name ____________________

Grade Level ____________________ Name of School ____________________

SECTION PHOTOGRAPHY Pre-Test ______________ Post-Test ______________

UNITS	STUDENT ASSIGNMENTS/ACTIVITIES	UNIT TEST	FINAL GRADE
1. Camera and Lens: Types and Uses			
2. Picture Making with Automatic Cameras			
3. Camera Construction and Operation			
4. Types of Black and White Film			
5. Developing Black and White Film			
6. Making Prints from Negatives			
7. Photographic Filters			
8. Photographic Papers			
9. Making Enlargements			
10. Photographic Activities			

STUDENT ACHIEVEMENT RECORD

Student's Name ____________________ Instructor's Name ____________________

Grade Level ____________________ Name of School ____________________

SECTION GRAPHIC ARTS Pre-Test ______________ Post-Test ______________

UNIT	STUDENT ASSIGNMENTS/ACTIVITIES	UNIT TEST	FINAL GRADE
1. Introduction			
2. Brock Printing			
3. Rubber Stamp Construction			
4. Hot Stamping			
5. Lithography/Offset Printing			
6. Silk-Screen Printing			
7. Posters			
8. General Safety			

CLASS COMPETENCY/PROGRESS RECORD

Instructor's Name ____________________ Communications:

Name of School ____________________ SECTION ELECTRICITY/ELECTRONICS

STUDENT'S NAME	UNIT SCORES																		AVERAGE

C 28

CLASS COMPETENCY/PROGRESS RECORD

Instructor's Name ____________________

Name of School ____________________

Communications:

SECTION DRAFTING/DESIGN

STUDENT'S NAME	UNIT SCORES																		AVERAGE

CLASS COMPETENCY/PROGRESS RECORD

Instructor's Name ______________________ Communications:

Name of School ______________________ SECTION PHOTOGRAPHY

STUDENT'S NAME	UNIT SCORES																		AVERAGE

C 30

CLASS COMPETENCY/PROGRESS RECORD

Instructor's Name ____________________ Communications:

Name of School ______________________ SECTION GRAPHIC ARTS

STUDENT'S NAME	UNIT SCORES																		AVERAGE

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

INTRODUCTION

DESCRIPTION OF UNIT

This unit contains a short history of electornic communications, a brief look at the FCC and a basic electronic commuications model. The materials in this unit are designed for 2 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify terms and definitions, discuss briefly the history of electronic communications, describe the FCC and its function and describe the elements of a basic electronic communications model.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match terms to the correct definitions and descriptions.
2. Answer questions with 80% accuracy over the history of electronic communications.
3. Describe the FCC and list 2 of its primary functions.
4. List and describe the 5 elements of a basic electronic communications model.

OUTLINE OF CONTENT

I. A Short History of Electrical Communication (From an FCC Information Bulletin)

The earliest method of distance communication was by runners who carried oral or written messages. After man domesticated the horse, riders were able to convey messages faster and farther.

For signaling purposes, primitive people used drum, fire, and smoke. Torches and fire towers figured in the Greek and Roman military campaigns. Agamemnon sent the news of the fall of Troy to his wife by flares along the way. Cyrus, king of the Persians, stationed men with strong lungs on hilltops to relay orders through hide megaphones. During the Crusades, Saladin dispatched messages by pigeons.

The ancients employed burnished metals to reflect the sun's rays for daytime signaling. Signal flags by day and flashing lights at night also were used.

Andrew Jackson fought the British at New Orleans after peace had been reached in the War of 1812 because of a lack of speedy communication to let him know of the war's end. Similarly during the Civil War, a Confederate raider destroyed Yankee whaling ships in the Arctic two months after Lee surrendered.

The colorful pony express required 10 1/2 days to carry mail from St. Joseph, Mo., to San Francisco.

Before the advent of the railroad, it took 44 hours for stagecoaches to carry news from Washington to New York City. Express riders cut this down to 20 hours. Trains now make the trip in 3 hours and jet planes in less than an hour. Trains have crossed the continent in 2 1/2 days and jet planes now make the trip in 5 hours.

In 1492 it took Columbus 70 days to reach the New World. Centuries later American clipper ships crossed the Atlantic in 2 weeks. Steamships have made the trip in 3 1/4 days, and jet passenger planes now span the ocean in about 6 1/2 hours.

However, telephone and telegraph are able to bridge the continent or sea almost instantaneously.

At the turn of the century, radio was confined to wireless telegraph, largely for marine purpose, and code communication for comparatively short distances. Today radio has many aural and visual communication uses on land, on the sea, and in the air.

That radio no longer is earthbound is evidenced by the development of space communication. Global telephone, telegraph and television services have been expedited and expanded by relay via space communication satellites. United States participation in such a system was authorized by Congress in 1962.

Invention of the steamboat and locomotive greatly reduced the time element in communication. But it remained for the telegraph to strengthen our national life and unity.

The principle of the electromagnetic telegraph was developed by Samuel F. B. Morse. While a professor of arts and design at New York University in 1835, he proved that signals could be transmitted by wire.

As in the case with many notable inventions, he had difficulty in arousing interest. He gave a public demonstration in 1838, but it was not until five years later that Congress appropriated $30,000 to construct an experimental telegraph line from Washington to Baltimore.

Early the next year 1844, members of Congress witnessed the sending and receiving of messages over a part of the line. Before the line had reached Baltimore, the Whig party held its 1844 national convention there and, on May 1, nominated Henry Clay. This news was hurried to Annapolis Junction (between Washington and Baltimore) where Morse's partner, Alfred Vail, wired it to the capital. This was the first news dispatch carried by electric telegraph.

"What hath God wrought?" sent by Morse from the old Supreme Court chamber in the United States Capitol to his partner in Baltimore, officially opened the completed line on May 24, 1844.

Three days later the Democratic National Convention met at Baltimore. Van Buren seemed the likely choice, but James K. Polk won the nomination. When this news was telegraphed to Washington, skeptics refused to believe it. Only after persons arriving by train from Baltimore confirmed the report, were many convinced of the telegraph's value.

Morse and his associates obtained private funds to extend their line to Philadelphia and New York. Small telegraph companies sprang up in the East, South, and Midwest. Dispatching of trains by telegraph started in 1851. Western Union commenced business the same year. It built the first transcontinental telegraph line in 1861, mainly along railroad rights-of-way.

The telegraph provided speedy communication at the time the West was being opened. Together with the railroad, the telegraph built up communities, opened markets, and promoted commerce.

Until 1877, all rapid long-distance communication depended upon the telegraph. In that year, however, a rival developed with the advent of the telephone. Patent litigation between Western Union and the infant telephone system was terminated in 1879 by an agreement that largely separated the two services.

In 1881, the competitive Postal Telegraph system entered the field. For economic reasons, Postal was merged with Western Union in 1943. Today only one company--Western Union--offers a nationwide telegraph service. Some independent telegraph companies exist, but they are small and mostly serve railroads or particular industries in limited areas.

Ocean cable telegraph--a sea-going extension of the land telegraph system to link islands and continents--also was pioneered by Morse. In 1842, over an insulated copper wire submerged in New York harbor, Morse demonstrated that electrical impulses could be sent under water. It remained for Cyrus W. Field to make the submarine cable practical.

With capital obtained from private subscriptions in New York and London and, in part, appropriated by the British and United States Governments, an attempt was made in 1857 to lay a cable under the Atlantic Ocean. The cable broke after 355 miles had been laid out by a ship operating from Ireland. The following June, another attempt failed. A cable was successfully laid the next month but it soon became inoperative. Another cable-laying effort, in 1865, proved futile.

On July 27, 1866, the steamship "Great Eastern" completed laying a new cable from Ireland to Newfoundland. Returning to mid-Atlantic, the ship located and raised the cable used in the 1865 attempt, spliced it, and extended it to Newfoundland, where it was landed on September 8. Thus, America and Europe were linked by two cables. Other ocean cables followed.

Through telegraph cables, international commerce was stimulated and the exchange of news became a matter of minutes instead of weeks.

Ocean cables were operated by manually repeating the messages along the route. In 1921 "regenerators" were developed for direct transmission between terminals. Less that 300 letters a minute could be sent over the original transatlantic cable. Modern "Permalloy" cables have a capacity of about 2,400 letters a minute.

> "If I can get a merchanism which will make a current of electricity vary in its intensity, as the air varies in density when a sound is passing through it, I can telegraph any sound, even the sound of speech."

So declared Alexander Graham Bell in 1875 while experimenting with his "harmonic telegraph." On June 2 of that year, by fashioning a makeshift diaphragm, this teacher of the deaf discovered he could hear over a wire the sound of a twanging clock spring.

Nine months later--on March 10, 1876--Bell transmitted the first complete sentence heard over a wire. What he said was, "Mr. Watson, come here, I want you." It was received by his associate, Thomas A. Watson, in an adjoining room of their tiny Boston laboratory.

United States Patent No. 174,465, issued to Bell in 1876, became recognized as the "most valuable patent." Yet early efforts to popularize the telephone met with disappointment. Though people paid to hear Bell lecture on "the miracle discovery of the age," for a time they seemed unaware of its possibilities.

However, 1877 saw construction of the first regular telephone line--from Boston to Somerville, Mass. At the close of 1880 there were 47,900 telephones in the United States. The following year brought telephone service between Boston and Providence. Service between New York and Chicago started in 1892, and between New York and Boston in 1894. But transcontinental service by overhead wire was not inaugurated until 1915.

Early telephones were leased in pairs. The subscriber had to put up his own line to connect with another. The first switchboard was set up in Boston in 1877. The first regular telephone exchange was established in New Haven in 1878. Early switchboards were manned by boys.

In the early days, many cities and towns had rival telephone systems. Philadelphia was the last major area to give up dual service, doing so in 1943.

The first bell telephone company started in 1878. It developed into the American Telephone and Telegraph Company (AT&T), incorporated in 1885. AT&T and its subsidiaries comprise the Bell System which provides a variety of communication services. Some 1,640 independent telephone companies also operate. Most of them connect with the Bell System.

Toward the close of the 19th century the myriad of overhead telephone wires in large cities became such an obstacle to effective fire fighting, and were so subject to snow and sleet damage that it was necessary to develop sturdier overhead cables. In 1888, 100 wires could be combined into a large cable; today more than 4,000 strands can be encompassed in a cable the size of an adult's wrist.

Experiments with underground telephone cable began in 1882, but it was not until 1902 that the first long-distance buried cable was placed in operation--between New York and Newark, N.J. The first cross-continent underground cable line was opened in 1942.

Submarine telephone cables have long connected this country with Cuba. The first transatlantic telephone cable--connecting Newfoundland with England--was opened in 1956. Later that same year a submarine telephone cable from the State of Washington to Alaska was put into operation. Hawaii was linked by telephone cable with the mainland in 1957, and a telephone cable to France began operation in 1959. Seven telephone cables now link North America and Europe.

The dial telephone was invented by Almon B. Strowger, a Kansas City undertaker, in 1889. The first dial exchange was installed at La Porte, Ind., in 1892. Most telephones now are dial operated.

The first coaxial cable experiment opened between New York and Philadelphia in 1936. One pair of coaxial units can carry simultaneously 1,860 telephone conversations or 600 conversations and two TV programs. Each of these 1,860 voice pathways also can be equipped to provide up to 18 telegraph circuits. Commercial service was inaugurated between Stevens Point, Wis., and Minneapolis in 1941. Coast-to-coast service was inaugurated in 1951 when the Japanese Peace Conference in San Francisco was televised.

Few radio broadcasts travel through the air exclusively, many are sent over telephone wires.

In the 1860's, James Clerk Maxwell, a Scottish physicist, predicted the existence of radio waves, and in 1886 Heinrich Rudolph Hertz, a German physicist, demonstrated that rapid variations of electric current could be projected into space in the form of radio waves similar to those of light and heat. A patent of a wireless system was issued in the United States as early as 1872.

But it remained for Guglielmo Marconi, an Italian inventor, to prove the feasibility of radio communication. Marconi sent and received his first radio signal locally in Italy in 1895. In 1899 he flashed the first wireless signal across the English Channel and two years later received the letter "S", telegraphed from England to Newfoundland. This was the first successful transatlantic radio transmission. Marconi also sent the first eastward transatlantic radiotelegraph message in 1902.

These activities aroused world interest. Sea disasters proved the new medium to be an effective aid in rescue work, as well as for communicating between ships and between ships and shore points, and a number of ocean liners installed wireless equipment. In 1899 the United States Army established wireless communication with a lightship off Fire Island, N.Y. Two years later the Navy adopted a wireless system. Up to then, it had been using visual signaling and homing pigeons.

The first international wireless conference was held at Berlin in 1903.

The first radio distress call from an American vessel (a Navy relief ship) occurred in 1905. But a radio operator named Jack Binns made world news in 1909 when he remained at his post on the stricken steamship Republic to summon aid with the British radio distress call "C Q D". Later that same year the S.S. Arapahoe brought help with "SOS," which was adopted as an international radiotelegraph distress call in 1906 and is still in use. ("May-day" was adopted in 1927 as the international distress call for radiotelephony.) In 1912 the ill-fated Titanic also resorted to wireless.

By international agreement in 1927, the alphabet was apportioned among the nations for basic use in radio calls to identify both the nationality and the type of radio stations.

In 1901, radiotelegraph service was inaugurated among five Hawaiian Islands; in 1903, a Marconi station at Wellfleet, Mass., carried an exchange of greetings between President Theodore Roosevelt and King Edward VII; in 1905 the naval battle of Port Arthur in the Russo-Japanese war was reported by wireless, and in 1906 the U.S. Weather Bureau experimented with radiotelegraphy to speed notice of weather conditions. In 1909, Robert E. Peary, arctic explorer, radiotelegraphed: "I found the Pole;" in 1910 Marconi opened regular American-European radiotelegraph service which, several months later, enabled an escaping British murderer to be apprehended on the high seas; and in 1912 the first transpacific radiotelegraph service linked San Francisco with Hawaii.

During the First World War, governments began using radiotelegraph to keep abreast of events and to direct the movement of troops and supplies. World War II demonstrated the value of radio and spurred its development and utilization for peacetime purposes. Radiotelegraph circuits to other countries enable persons almost anywhere in the United States to communicate with practically any place on the globe.

Pictures have been transmitted by radio since 1923, when a photograph was sent from Washington to Baltimore in a test. The first transatlantic radiophoto relay came in 1924 when the Radio Corporation of America beamed a picture of Charles Evans Hughes from London to New York. RCA inaugurated regular radiophoto service in 1926.

At present there is no domestic all-radiotelegraph service on a national basis. Two radio communication companies once had domestic networks connecting certain large cities, but these were closed in World War II and were not reopened. However, microwave and other developments make it possible for domestic telegraph communication to be carried in substantial part over radio circuits. In 1945 Western Union established the first microwave beam system, connecting New York and Philadelphia. This has since been extended and is being developed into a coast-to-coast system. Over present links Western Union can transmit about 2,000 telegrams simultaneously in each direction.

The first time the human voice was sent by radio is a subject for debate. Claims to that distinction range from "Hello Rainey" spoken by Nathan B. Stubblefield to a partner in test near Murray, Ky., in 1892, to an experimental program of talk and music by Reginald A. Fessenden of Brant Rock, Mass., in 1906, which was heard by radio-equipped ships within several hundred miles.

In 1915 speech was first transmitted across the continent--New York City to San Francisco--and across the Atlantic Ocean--from Naval radio station NAA at Arlington, Va., to the Eiffel Tower in Paris. There was some experimental military radiotelephony in World War I between ground and aircraft.

The first ship-to-shore two-way radio conversation occurred in 1922, between Deal Beach, N.J., and the S.S. America, 400 miles at sea. However, it was not until 1929 that high seas public radiotelephone service was inaugurated. At that time telephone contact could be made only with ships within 1,500 miles of shore. Today it is possible to telephone nearly every large ship wherever it may be on the globe.

Commercial radiotelephony linking North America with Europe was opened in 1927, and with South America three years later. In 1935 the first telephone call was made around the world, using both wire and radio circuits.

Until 1936, all American transatlantic telephone communication had to be routed through England. In that year a direct radiotelephone circuit was opened to Paris. Others to other countries followed. Telephone connection by radio and cable is now possible with more than 180 foreign points.

Microwave telephone transmission was first sent across the English Channel in 1930. A microwave telephone system, between Boston and New York, went into operation in 1947. The first overseas telephone call from a moving automobile was made from St. Louis to Honolulu in 1946.

It was not until after World War I that regular broadcasting began. The first system used was AM (amplitude modulation).

Licensing of broadcast stations on a regular basis began in 1921 with WBZ, Springfield, Mass., the first station licensed. Some broadcast stations developed from experimental operations prior to that date. A pioneer in this respect was KDKA, Pittsburgh.

Experimental network operation over telephone lines existed as early as 1922. President Coolidge's message to Congress was broadcast by six stations in 1923. In 1926 the National Broadcasting Company started the first regular network with 24 stations. Its first coast-to-coast hookup was in 1927. In that year the Columbia Broadcasting System was organized. The first round-the-world broadcast occurred in 1930.

Before 1923, radio broadcast was localized. Today, through telephone lines, coaxial cable, microwave, and other relay means, the same live program can be sent over many stations at the same time, or by recordings (videotape and film in the case of TV), so the same program can be used at times to suit programming schedules of individual stations.

Though a patent on frequency modulation (FM) was issued in 1902, the principle of FM had been known previously. However, its advantages for broadcasting were not developed until shortly before World War II. Largely as a result of developmental work by Edwin H. Armstrong in the 1930's, the Federal Communications Commission in 1940 authorized commercial FM broadcasting to start January 1, 1941.

There was no "first" individual commercial FM authorization because, on October 31, 1940, the Commission granted construction permits to 15 stations simultaneously. The first licensed commercial FM station was WSM-FM, Nashville (May 29, 1941), which operated until 1951.

To enable FM broadcasters to obtain additional revenue, the Commission in 1955 authorized them to provide a supplemental "background music" service to subscribers. The signal is, in effect, "piggy-backed" on regular programs for reception on special sets in stores, factories, etc.

In 1961 the Commission authorized FM stations to engage in stereophonic broadcast. This involves dual transmission and reception to give a more realistic effect to music and other sound.

The beginning of visual radio has been traced to 1884 when Paul Nipkow, a German, patented a scanning disk for transmitting pictures by wireless. In the United States Charles F. Jenkins began study of the subject about 1890. Rignoux and Fournier conducted "television" experiments in France after the turn of the century. In 1915 Marconi predicted "visible telephone." In 1925 Jenkins demonstrated his mechanical TV apparatus. A year later there were experiments by E.F.W. Alexanderson, Philco T. Farnsworth and John L. Baird.

An experimental TV program was sent by wire in 1927 between Washington and New York by the Bell Telephone Laboratories. The next year an outdoor pick-up was tested. Large screen TV was demonstrated in a New York theater in 1930.

Seventeen experimental TV stations were operating in 1937. An experimental mobile TV station was placed in use that year. The first United States President seen on TV was Franklin D. Roosevelt, when he opened the New York World's Fair in 1939.

In 1939 the Milwaukee Journal filed the initial application to broadcast TV programs on a commercial basis. As a result of a hearing in 1940, the Commission authorized commercial TV operation to start July 1, 1941.

Meanwhile, a number of TV stations, which had been operating experimentally, applied for commercial authorization. The first grant for regular TV operation was issued to WNBT, New York, on June 17, 1941, effective July 1 of that year.

As a result of proceedings that started in 1948, the Commission on April 14, 1952, added 70 UHF (Ultra High Frequency) channels to the 12 VHF (Very High Frequency) channels then used for TV broadcast, thus making more than 2,000 channels available for assignment in nearly 1,300 communities throughout the United States and its territories. TV sets made after April 30, 1964, must be able to receive UHF and VHF channels.

Color television had long been a subject for study and experimentation. In 1928 Baird, in England, demonstrated one system. The next year color was sent over wire in a test at the Bell Telephone Laboratories.

Color TV was considered initially by the FCC in 1941, when it proposed alternative standards for monochrome and color. In 1945 it allocated certain UHF frequencies for experimentation in developing color and high definition black-and-white TV. In 1946 it received a formal proposal for the adoption of color standards.

Proceedings in 1949 and 1950 resulted on October 11, 1950, in the Commission's adopting a color system that required special receivers or adapters. The FCC held the door open, however, for consideration of subsequent developments and, as a result, adopted the present "compatible" color system on December 17, 1953.

The FCC authorized pay-TV (involving special programs for subscribers) as early as 1950. Five years later it proposed trial of such a service but, because of Congressional committee resolutions, deferred further action until 1959 when it invited applications by commercial TV stations to test toll-TV. The first such grant ws made on February 24, 1961, to WHCT, Hartford, Conn. Subscription TV was established as a regular broadcast service on December 12, 1968.

University engineers helped to construct some of the nation's pioneer AM broadcast stations, and many early broadcast licenses were issued to educational institutions.

By 1925, educational groups held 171 licenses. For various reasons, most of these stations were off the air when the Federal Communications Commission was created in 1934. However, some educational bodies still operate in the AM band, either commercially or without profit.

To encourage the development of noncommercial educational broadcasting, the Commission in 1938 set aside certain AM channels for the exclusive use of educational institutions. Only a few institutions applied, and most later changed to FM when the Commission allocated FM channels for noncommercial educational use, starting in 1941.

As an additional incentive to educational broadcasting, the Commission in 1948 authorized low power (10 watts) for noncommercial educational FM stations.

In its television decision in 1952, the Commission allocated 242 TV channels for noncommercial educational purposes. This later was increased to 655.

The first noncommercial educational TV grant was made July 23, 1952, to the Kansas State College of Agriculture and Applied Science (KSAC-TV), but that station was not built. The first such station to go on the air was KUHT, Houston, in 1953.

Cable TV was developed initially in the late 1940's in communities unable to receive television signals because of terrain or distance from TV stations. Master antennas were built to pick up broadcast station signals and feed them by cable to subscribers for a fee.

In 1950, there were 70 cable TV operations in the United States, serving 14,000 subscribers. At the close of fiscal 1973 there were almost 3,000 cable systems serving well over 7.25 million homes in some 5,700 communities.

Cable offers clearer pictures than home antennas, particularly for color TV, and can offer larger numbers of channels for TV signals and various other services. Many systems feature separate channels for weather, stock market reports, wire service news, and FM radio. Some cable operators originate their own programs.

The average cable system has 2,200 subscribers. The largest--in San Diego--has over 57,000; some have fewer than 100. Most systems offer between 6 and 12 channels, the average being 10. Cable TV systems are capable of offering up to 60 different channels. The average monthly fee is $5 for service; installation fees range from gratis to about $100, but the average is $20.

The cable industry had total subscriber revenues estimated at 391 million in 1971. Cable systems are still concentrated in smaller communities; over half of the systems serve fewer than 1,000 homes each. In large metropolitan areas, where reception is a problem because of the "canyons" created by tall buildings, the number of cable subscribers is increasing.

The Commission asserted limited jurisdiction over cable TV in 1962, first establishing rules in 1965 for those systems which received signals by microwave. (Microwave stations have always been FCC licensed.) In 1966, the Commission established rules for all cable systems, whether served by microwave or not. An extensive revision of the rules was adopted February 2, 1972 and became effective March 31, 1972.

Amateur radio is almost as old as marine radio. There was some amateur operation at the turn of the century and, in 1912, several hundred self-styled "hams" were in radiotelegraph communication with one another or listening-in on marine telegraph transmissions. The amateur fraternity, which now also uses radio-telephony, has been highly instrumental in popularizing and advancing the radio art.

Police radio is also among the older public safety services. In 1916 the New York City Police Department began operating a radio station to communicate with its harbor patrol boats. The Detroit Police Department experimented with radio comunication in 1921, using the call letters "KOP." The first state police radio system was established in 1923 by Pennsylvania. The first construction permit for a two-way police radio system went to Bayonne, N.J., in 1932, but Port Jervis, N.Y., obtained the first license.

Today radio is employed for a wide variety of purposes. In addition to broadcasters and common carriers, the FCC regulates such non-Government radio services as aviation; marine; public safety (police, fire, local government, forestry conservation, special emergency and highway maintenance); industrial (business, manufacturing, forest products, petroleum, power, etc.); land transportation (railroads, passenger buses, trucks, taxicabs, automobile emergency, etc.); disaster communications; research and experimental; and individuals who use radio as a livelihood, hobby or personal convenience (commercial and amateur operators and private citizens).

II. The FCC in Brief
(From an FCC Information Bulletin)

1. What is the Federal Communications Commission?

   It is the United States Government agency charged with regulating interstate and foreign communication by means of radio, television, wire, cable, and satellite.

2. What is the Object of FCC Regulation?

   To provide for orderly development and operation of radio* services, to make available a rapid, efficient, nationwide and worldwide telegraph and telephone service at reasonable charges; to promote the safety of life and property through the use of wire and radio communication; and to employ communication facilities in the national defense.

3. Is the FCC Under Any Government Department?

   No. It is an independent Federal agency created by Congress and, as such, reports directly to Congress.

4. How Did the FCC Come Into Being?

   Jurisdiction over wire and radio communications at various times was handled by the Department of Commerce, Post Office Department, Interstate Commerce Commission and the Federal Radio Commission. Technological developments and interference necessitated coordination of these regulatory functions in a single agency. The Communications Act, signed June 19, 1934, created the Federal Communications Commission for that purpose.

*Radio is used here in all-inclusive sense and refers to television as well as other broadcasting and nonbroadcasting uses.

5. Is the Communications Act Limited to the 50 States?

No. It applies also to Guam, Puerto Rico, and the Virgin Islands, but not to the Canal Zone.

6. What are the FCC's Major Activities?

It allocates bands of frequencies to non-Government communications services and assigns frequencies to individual stations; licenses and regulates stations and operators; regulates common carriers in interstate and foreign communications by telegraph, telephone, and satellite; promotes safety through the use of radio on land, water, and in the air; encourages more effective and widespread use of radio; utilizes wire and radio communication services in national defense. It does not regulate radio operations by the Federal Government.

7. How is the FCC Administered?

The FCC consists of seven Commissioners appointed by the President with the approval of the Senate. No Commissioner can have a financial interest in any Commission-regulated business. No more than four Commissioners may be members of the same political party. Appointments are for seven years, except in filling an unexpired term. The salary of a Commissioner is $50,000 a year; the Chairman receives $52,000. One of the Commissioners is designated Chairman by the President. The Chairman's tenure during his term of office is at the pleasure of the President.

8. How Does the FCC Function?

The Commissioners function as a unit, supervising all FCC activities, with delegations of responsibilities to boards and Committees of Commissioners, individual Commissioners, and staff units. The Chairman is responsible for the general administration of the internal affairs of the Commission.

Policy determinations are made by the Commission as a whole. Commission practices conform to the Communications Act of 1934, as amended, the Administrative Procedure Act, and other applicable laws.

The FCC staff is organized on a functional basis. There are five operating bureaus--Broadcast, Cable Television, Common Carrier, Field Operations, and Safety and Special Radio Services--and six staff offices--Executive Director, General Counsel, Chief Engineer, Opinions and Review, Administrative Law Judges, and the Review Board.

9. What Does the FCC Field Staff Do?

It is engaged largely in engineering work. This includes monitoring the radio spectrum to see that station operation meets technical requirements, inspecting stations of all types, conducting operator examinations and issuing permits or licenses to those found qualified, locating and closing unauthorized transmitters, furnishing radio bearings for aircraft or ships in distress, locating sources of interference and suggesting remedial measures, doing special engineering work for other Government agencies, and obtaining and analyzing technical data for Commission use.

10. How Does the FCC Cooperate With Other Agencies?

In international and national matters, it works with various Government agencies involved with radio and wire communication. It also cooperates with state regulatory commissions in telephone and telegraph matters of mutual concern, largely through the National Association of Regulatory Utility Commissioners. It also cooperates with radio-user groups.

11. How Many Persons Does the FCC Employ?

About 2,100 regular employees, of whom more than one-fourth are engaged in field engineering. With few exceptions, FCC personnel is under Civil Service.

12. What Does FCC Regulation of Radio Include:

This involves consideration of applications for construction permits and licenses for all classes of non-Government stations; assignment of frequencies, power, and call signs; authorization of communication circuits; modification and renewal of licenses; inspection of transmitting equipment and regulation of its use; control of interference; review of technical operation; licensing of radio operators (commercial and amateur); remedial action when necessary, and other implementation of the Communications Act. The Commission does not license sets used for reception only.

13. How Are Broadcast Stations Regulated?

This FCC function includes allocation of spectrum space for AM and FM radio and VHF and UHF television broadcast services; assignment of frequencies and call letters to stations; designation of operating power and sign-on and sign-off times. The Commission also issues construction permits and inspects technical equipment.

While the FCC is prohibited by law from censoring program content, it does have many regulatory responsibilities in the program area. For example, it requires licensees to attempt to ascertain and serve the programing tastes, needs and desires of their communities. Licensees are also obligated to comply with statutes, rules, and policies relating to program content, such as identification of all sponsored broadcast matter, broadcasting information only on state-operated lotteries in their own or adjacent states.

The FCC also requires licensees to make available equal opportunities for use of broadcast facilities by political candidates. It also enforces rules on personal attacks, editorials endorsing or opposing political candidates, station identification, identification of recorded programs or program segments, and publicly declared Commission policies on fairness in the presentation of controversial issues. The FCC requires licensees to prevent use of their facilities for false or misleading advertising.

The Commission conducts inquiries and investigations. Licensees who have violated FCC statutes, rules, or policies are subject to sanctions including loss of license and fines up to $10,000.

The Commission conducts inquiries and investigations. Licensees who have violated FCC statutes, rules, or policies are subject to sanctions including loss of license and fines up to $10,000.

The Commission limits the number of broadcasting outlets that any one individual or company may own to a total of seven AM, seven FM and seven TV stations (only five of which can be VHF). The same owner cannot operate more than one station of the same kind in the same place.

Since broadcasting stations are not common carriers, the Commission does not regulate rates, profits, accounting methods, or other financial aspects of station operations.

14. How Are Common Carriers Regulated?

In addition to licensing radiotelephone circuits and assigning frequencies for their operation, the FCC supervises charges, practices, classifications, and regulations in interstate and foreign communication by radio, wire and cable; considers applications for construction of new facilities and discontinuance or reduction of service; acts on applications for interlocking directorates and mergers, and prescribes and reviews the accounting practices of communication carriers.

The Commission does not regulate purely intrastate wire services; they are under the jurisdiction of their respective state utility commissions.

15. Can Aliens Hold Radio Licenses?

The radio license privilege is limited essentially to citizens of the United States. It is generally denied to aliens or their representatives, foreign governments or their representatives, foreign corporations, and domestic corporations with alien officers, directors or more than one-fifth of their capital stock owned or voted by alien interests.

In the interest of air study, certain noncitizen aircraft pilots holding United States pilot certificates who must use radio in their piloting duties may hold licenses. Under reciprocal agreements with a number of other nations, alien radio amateurs may be authorized to operate their stations while visiting the United States.

A radio station may also be held by an alien in the case of vessels and aircraft required by an act of Congress or by treaty to carry radio. Commercial radio operator licenses and permits generally are granted only to United States citizens.

16. What Are Some Types of Broadcast Services?

The list includes the older standard or AM (amplitude modulation); FM (frequency modulation), commercial and noncommercial educational, including stereophonic; TV (television), commercial and noncommercial educational, also Pay-TV; international (except stations operated by the Government); supplemental services such as FM functional music, TV translators, remote pickup and studio-transmitter link; and experimental and developmental services.

The Commission does not license cable TV (community antenna) or closed circuit (wired) TV systems since they do not transmit over the air. It does, however, regulate cable through issuance of certificates of compliance to systems that have received franchises from their local governing body. It also regulates TV importation of signals from other TV markets.

17. What Are Some Other Radio Services?

These include Aviation (aircraft and ground); Marine (ship and coastal); Public Safety (police, fire, forestry conservation, highway maintenance, local government, special emergency, and state guard); industrial (business, forest products, manufacturers, motion picture, petroleum, power, relay press, special industrial, and telephone maintenance); Land Transportation (railroad, passenger and truck, taxicab, and automobile emergency); Amateur, Personal, Disaster and Experimental; also Common Carrier (paging, land mobile, microwave relay, broadcast relay, and international radiotelephone and radiotelegraph services).

18. How Are Station Call Signals Assigned?

International agreement provides for national identification of a station by the first letter or first two letters of its call signal, and for this purpose apportions the alphabet among the nations. The United States uses the initial letters K, N, and W exclusively and part of the A series. Call signals are assigned by the Commission on an individual basis.

The initial letter N is reserved for the Navy and Coast Guard, while A, K, and W are shared by other Government and non-Government stations. Broadcast station calls begin with K or W. Calls prefixed by K identify stations located west of the Mississippi River, while W is used east of the river, except for some long established stations whose call letters were allocated before the assignment rule was adopted.

19. What Is the FCC Role in International Matters?

It is charged with domestic administration of telecommunication provisions of treaties and international agreements which the United States is a party. Under Department of State auspices, it participates in related international conferences. It licenses radio and cable circuits from the United States to foreign points and regulates the operating companies.

It also licenses radio stations on American planes and ships in international service, and, under international agreements and upon request, inspects the radio equipment of foreign vessels touching our ports. Further, it is the medium for resolving cases of interference between domestic and foreign radio stations.

20. What About Safety of Life and Property?

The Communications Act stipulates: "For the purpose of obtaining maximum effectiveness from the use of radio and wire communications in connection with safety of life and property, the Commission shall investigate and study all phases of the problem and the best methods of obtaining the cooperation and coordination of these systems." Radio installations on vessels and aircraft, also police, fire, forestry and other protective radio systems are in this category.

21. How Does Radio Aid Business?

Besides affording a speedy means of communication and being a factor in protecting life and property, radio contributes to economies and improvements in public and private business operations. It has become an important adjunct to rail, highway, water and air transportation, to public utility, industrial and other business operations.

22. Does the FCC Engage in Studies and Research?

The Commission is required to "study new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest." Cooperation is maintained with Government and commercial research and development groups. In connection with its research activities, the FCC operates a laboratory at Laurel, Maryland. It also carries out policy studies to provide information on complex questions facing the Commission.

23. What is the FCC's Role in National Defense?

Wire and radio communication facilities used to aid the national defense form one of the basic requirements of the Communications Act. The President has delegated certain of these functions to the FCC. Among other things, the Commission supervises the Emergency Broadcast system to notify and instruct the public in the event of enemy attack. This system is put to peacetime use for broadcasting information and instructions about local and statewide emergencies. The FCC cooperates with Federal, State, and local authorities in the preparation of emergency plans and, in turn, has the cooperation of public and industry elements concerned.

24. Where Can One Get More Reference Material?

Those interested in more detail about the Commission may purchase various FCC printed publications from the Government Printing Office or obtain free single copies of information bulletins from the FCC. Lists will be furnished on request to the Public Information Office, Federal Communications Commission, Washington, D.C. 20554.

III. Electronic Communications

A. A Basic Model--All forms of communication are made up of five elements. These elements are as follows:

1. Information Source
2. Encoder or Transmitter
3. Message Channel
4. Decoder or Receiver
5. Information Destination

It can readily be seen that these are the 5 essential elements of all communication forms regardless of the form. What comprises these elements may change from form to form, but each element will do basically the same thing in each form. That is to say that while the message channel in radio could be wire or radio waves and the message channel in human speech sound waves, they both function in the same manner which is to provide a channel through which information may travel.

For their use in electronic communications, these 5 elements are defined as follows:

1. Information source--This is where the information originates and where it is converted into an electrical signal.

2. Encoder or transmitter--It is here that the signal from the source is encoded, (if necessary), amplified and transmitted.

3. Message channel--This is the medium over which the transmitted signal rides.

4. Decoder or receiver--Here the opposite of #2 takes place. The transmitted signal is broken down and the usable portion is sent on.

5. Information destination--It is here that the information is changed from an electrical signal back into its original form.

B. Systems

1. Radio--A system of communication using electromagnetic waves for the transmission and reception of signals through the atmosphere.

2. Telegraph--A communications system that employs a code made up of interruptions or polarity changes of direct current for the transmission and reception of signals primarily over wire.

3. Telephone--A communications system used for transmitting and receiving sound waves produced by the human voice to and from distant points primarily over wire.

4. Television--A system of communication employing the transmission and reception, through the atmosphere, of images of fixed or moving objects, usually accompanied by sound.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheets and go through the outline of material.

V. Give test.

STUDENT ACTIVITIES

I. Read objective sheet

II. Study information sheets

III. Take test

REFERENCES/RESOURCES

References:

1. Ress, Etta Schneider, Signals to Satellites, Mankato, Minnesota, Creative Educational Society Inc., 1965. (j384)
2. Hogben, Lancelot, The Wonderful World of Communication, Garden City, New York, Doubleday and Company Inc., 1969.

Resources:

1. Public Information Office, Federal Communications Commission, Washington, D.C. 20554.
2. Information Sheets.
3. Transparency Masters.

Information Sheet #1

Terms and Definitions:

1. Communication--The process of exchanging ideas and information.
2. Electronic communication--Communication where electronic devices are used for the sending and receiving of information.
3. FCC--Federal Communications Commission.
4. Radio--A system of communication using electromagnetic waves for the transmission and reception of signals through the atmosphere.
5. Telegraph--A communications system that employs a code made up of interruptions or polarity changes of direct current for the transmission and reception of signals primarily over wire.
6. Telephone--A communications system used for transmitting and receiving sound waves produced by the human voice to and from distant points primarily over wire.
7. Television--A system of communication employing the transmission and reception, through the atmosphere, of images of fixed or moving objects, usually accompanied by sound.

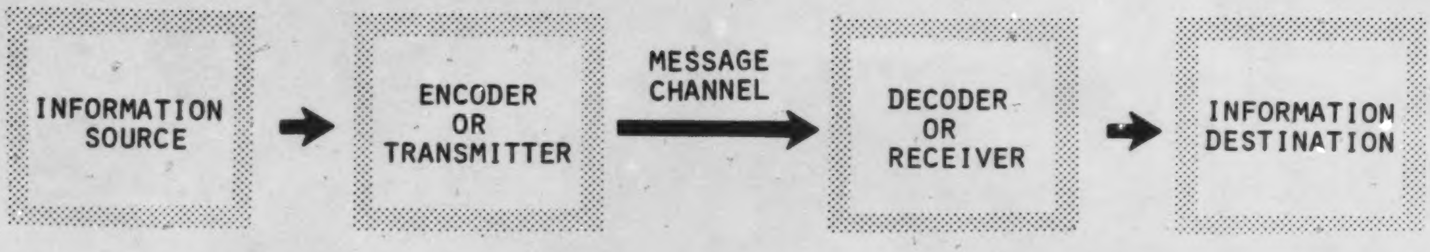
EE 1.25

Information Sheet #2

IMPORTANT DATES IN ELECTRICAL COMMUNICATION

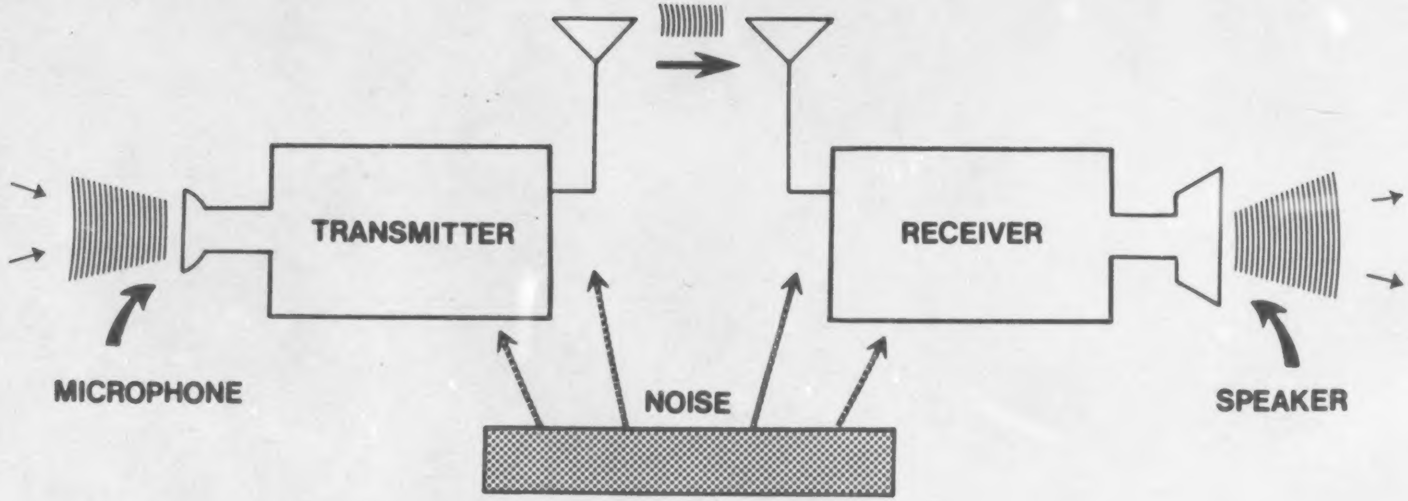
1835	Telegraph invented by Samuel F.B. Morse
1844	First news dispatch sent over telegraph
1861	First transcontinental telegraph line
1866	First successful transatlantic telegraph cable laid
1876	Telephone invented by Alexander Graham Bell
1878	First telephone company started
1889	Dial telephone invented by Almon B. Strowger
1892	First dial telephone exchange installed in LaPorte Ind.
1895	Radio invented by Guglielmo Marconi in Italy
1902	First transatlantic radio telegraph message sent
1906	First radio program aired
1915	First time speech was transmitted across the continent
1921	First AM radio station licensed--WBZ in Springfield, Mass.
1922	First ship-to-shore two-way radio conversation
1923	First photo transmitted by radio
1926	First commercial radio network started with 24 stations--NBC, National Broadcasting Company
1927	First experimental TV station
1930	First round the world radio broadcast
1934	FCC was created
1935	First round the word telephone call
1941	First grant for regular TV was issued to WNBT in New York Also first FM radio station licensed--WSM-FM in Nashville, TN
1942	First transcontinental underground telephone cable
1945	Western Union established first microwave beam system
1960	First passive communications satellite launched-- Echo-I
1962	First active communications satellite launched-- Telstar-I

BASIC COMMUNICATION MODEL



INFORMATION SOURCE → ENCODER OR TRANSMITTER → MESSAGE CHANNEL → DECODER OR RECEIVER → INFORMATION DESTINATION

PRACTICAL ONE-WAY COMMUNICATIONS MODEL


TRANSMITTER
RECEIVER
MICROPHONE
NOISE
SPEAKER

SUGGESTED TEST

True and False:

T F 1. The FCC stands for the Florida Citrus Commission.

T F 2. Communication is the process of exchanging of ideas and information.

T F 3. The telegraph was invented in 1914.

T F 4. Alexander Graham Bell invented the telephone.

T F 5. The first FM station in this country was WSM-FM.

T F 6. Thomas Edison invented the radio.

T F 7. The FCC regulates all interstate and foreign electronic communication.

T F 8. All broadcast radio and TV station have call letters beginning with either a K or a W.

T F 9. A message channel is the medium over which a transmitted signal rides.

T F 10. The final portion of the communications model is the receiver.

ANSWERS TO TEST

1. F
2. T
3. F
4. T
5. T
6. F
7. T
8. T
9. T
10. F

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

ELECTRICITY

DESCRIPTION OF UNIT

This unit will cover basic electrical concepts. It will give an overview of the following areas: What is electricity, sources of electricity, effects of electric shock, methods of transmission, uses of electricity, and electrical measuring devices. The materials in this unit are designed for 7 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify electrical terms and definitions, list and describe sources of electricity, describe the effects of electric shock, describe how electricity is transmitted, and list several uses of electricity. The student will also be able to demonstrate the ability to select and properly use electrical measuring devices.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given electrical terms to the correct definition or description.
2. List and describe the 6 sources of electricity.
3. Describe the effects of electric shock.
4. Describe how electricity is transmitted.
5. List at least 2 industrial and 5 residential uses of electricity.

6. Demonstrate the ability to:

   A. Measure voltage with a VOM.

   B. Measure current with a VOM.

   C. Measure resistance with a VOM.

   D. Read a kilowatt hour meter.

OUTLINE OF CONTENT

I. What is Electricity

Electricity is the movement of electrons along a conductor. Electricity, the term applies to the field of study where current flows primarily through solid wire conductors of various kinds.

A. Matter--Anything that occupies space and has mass is called matter. All matter can be placed into 1 of 2 groups: elements and compounds.

1. Element--Any matter where the smallest particle of that matter, which contains all the chemical properties of that matter, is the atom. There are presently 106 known elements. Ninety two of these occur in nature and the other 14 are man made.

2. Compound--Composed of 2 or more elements. The smallest particle of a compound that has all the chemical properties of that compound is a molecule.

B. Atom--(See T.M.-1) Smallest unit of an element that contains all the chemical properties of that element. The atom is made up of a nucleus, containing neutrons and protons, and electrons orbiting around the nucleus in various energy levels.

1. Electron--Fundamental unit of negative charge. It orbits the nucleus of an atom.

2. Proton--Fundamental unit of positive charge. It is contained inside the nucleus.

3. Neutron--The neutron is neutral in charge and also dwells inside the nucleus.

4. Energy level--Levels of energy around the nucleus of an atom in which the electrons orbit. The energy level of an electron is proportional to its distance from the nucleus. The closer to the nucleus, the less energy and the farther away from the nucleus the more energy. There are seven of these energy levels and each level can contain only a specific maximum number of electrons.

5. Neutral atom--In its natural state an atom of any element has an equal number of electrons and protons and therefore the negative charge of the electrons is equal to the positive charge of the protons thus the net charge of the atom is neutral.

6. Isotope--An atom that has an equal number of electrons and protons but has more or less neutrons than the "parent" element.

7. Ion--An atom that has gained or lost an electron. If it gains an electron it is a negatively charged ion and if it loses an electron it is a positively charged ion.

C. Free electrons--If electrons are acted by heat or light or if they collide with other atomic particles they gain energy. As they gain energy they can change levels and move away from the nucleus. If they gain enough energy they break away from the pull of the nucleus and thus become free moving electrons. They move around in a random motion until they lose their extra energy and then through a process known as recombination they once again become part of an atom. It is these free electrons that make current flow possible.

D. Conductor--Element or compound with many free electrons. Provides a path of low resistance to current flow. The more free electrons the better the conductor.

E. Insulator--Element or compound with few or no free electrons. Provides high resistance to current flow.

F. Coulomb--Physical unit of electrical charge. Represents the combined charge of 6.25×10^{18} electrons.

G. Current--(Symbol is I) The flow of elecrons through a conductor. This electron flow occurs when a voltage is placed across a conductor causing the free electrons to move along the conductor in one direction rather than in a random manner.

1. Ampere--Unit of measurement of current flow. One amp is equal to 6.25×10^{18} electrons flowing past a given point in 1 second; or 1 colomb/second.

2. Alternating current--Changes directions of flow with respect to time. The speed with which current alternates is called cycles per second or Hertz (unit of measurement of cycles per second). In the USA we use 60 cycle AC. It changes direction of flow 60 times each second. The basic waveform of ac current is the sine wave. The sine wave is also the basic waveform of the entire electromagnetic wave spectrum. (See Transparency Master)

3. Direct current--Does not change direction of flow with respect to time.

4. Conventional flow--Theory that states that electrons flow from an area of positive to an area of negative charge.

5. Electron flow--Theory that states that electrons flow from negative to positive.

   (NOTE: It is not known for sure which theory is correct although the electron flow theory has wider acceptance. It really makes no difference which theory you subscribe to as long as when you are doing calculations you stick completely to one or the other. You cannot change theories in midstream.)

H. Voltage--(Symbol is E) Electromotive force provided by a difference in potential. Voltage does not flow; it provides the push or force that causes current to flow.

   1. Difference in potential--When one area is negatively charged and another area is positively charged there is said to be a difference in potential between the two areas. Due to the fact that everything in the universe is trying to reach a neutral or balanced state, this difference in potential provides a force that will push electrons along a conductor thereby causing current flow.

   2. Volt--Unit of measurement of electromotive force, or voltage. One volt is the amount of voltage required to push 1 amp of current through 1 ohm of resistance in one second.

I. Resistance--(Symbol is R) Anything that opposes current flow is called resistance. Opposite of resistance is conductance.

   1. Ohm--Unit of measurement of resistance.

   2. Mho--Unit of measurement of conductance.

J. Power--The time rate of doing work. This has to do with how fast one form of energy is converted to another form of energy to do work.

   EX: The speed with which electric energy is converted into mechanical energy in an electric motor.

   1. Watt--Unit of measurement for electrical power.

   2. Horsepower--Unit of measurement for motors and engines.
      1 horsepower=746 watts

K. Greek Prefixes--These prefixes are used to denote quantities. (See Information Sheet #3)

L. Electrical shock--Electricity is very dangerous and should always be treated with much respect. Anytime electricity flows across the body the body is said to have been shocked. If the current value is high enough then severe damage can be done to the body. (See Information Sheet #2) (Note that household wall current is enough to kill if the conditions are right.)

II. Sources of Electricity

A. Friction ("Static Electricity") (ex. wool cloth rubbed across a plastic comb)--Friction causes electrons to be attracted from one material to another thereby creating an area of negative charge. Static voltages can be high and can be a hazard. (ex: Gasoline trucks drag a chain on the highway to keep the truck grounded, thereby preventing a buildup of static charge which could cause a spark and in turn an explosion.)

B. Chemical--(Demonstration #1) (ex: lead-acid battery) Electrodes react with an electrolyte causing them to become positive and negative charged with respect to each other.

C. Heat--(Demonstration #2) (ex: thermocouple) When two dissimilar metals, which are in contact with each other, are heated, a difference in potential is developed between the two metals.

D. Light ("photoelectric")--(Demonstration #3) (ex: solar cell) When light strikes a photocell of any kind, electrons are driven from one material across a barrier to another material thus setting up a difference in potential between the two materials.

E. Pressure ("piezoelectric")--(ex: diamond needle on a record player) When pressure is applied to certain crystal substances, such as diamond, a voltage is developed across the surfaces.

F. Magnetism--When magnetic lines of force cut across a conductor or a conductor cuts through magnetic lines of force a current is induced in the conductor. (NOTE: Some people have stolen electrical power using this principle. They attach a large coil of wire to a long pole and place the coil near or against a primary power line. The lines of force around the power line cut the coil and a current is induced into the coil thereby providing "free" electricity. The power company knows that something is happening because their meters show that power is being drained from the line and they check until they find what is causing the leak. If a person is caught stealing power, the power company has the right to determine the amount of power you have to pay for, and what they say goes.)

III. Batteries

A. Battery--Grouping of two or more cells of any kind. Examples: chemical battery is made of 2 or more chemical cells, solar battery is made of 2 or more solar cells.

B. Dry cell--(ex: flashlight cell) Stores chemical energy and not electrical. Produces electrical energy from chemical energy. Electrolyte is a dry material; as opposed to a liquid. It could be a paste.

C. Wet cell--(ex: one cell of a lead-acid "car" battery) This cell has a liquid electrolyte. It converts chemical energy to electrical energy but this type cell can be recharged with electrical energy thereby gaining the name "storage battery".

D. Exotic cell--(ex: fuel cell) Any cell that produces electrical energy in a manner that is not conventional.

IV. Magnetism

A. Laws of magnetism--(Demonstration #4) Unlike poles attract; like poles repel.

B. Natural magnets--Called "lodestones", they come from iron ore that has been magnetized by the earth's magnetic field. They will not lose their magnetism. The earliest use of lodestones was compass points.

C. Electromagnets--(Demonstration #4) A magnetic field is set up around every current carrying conductor. If the conductor is wound into a coil the field is concentrated in the center. If a piece of ferrous material is then inserted into the center to form a core, a strong magnetic field will then set up in the ferrous material. When the current is stopped, only residual magnetism will be noted in the core material.

D. Magnetic flux--Magnetic lines of force are called flux lines.

E. Solenoid--Electromagnet with a moving core. The core is iron and is spring loaded and when current is sent through the coil the resulting magnetic field sucks the iron core into the coil. When the current flow is stopped the spring forces the iron core out of the coil (ex: doorbell works on this principle).

F. Relay--Control device consisting of a set of contacts controlled by an electromagnet. Relays come normally open and normally closed. In a normally open relay the contacts are open until the electromagnet is activated in which case the contacts are pulled closed and current is allowed to flow. When the electromagnet is deactivated the contacts open and current flow stops. A normally closed relay works just reverse to this. (ex: buzzer works on this principle).

V. Electrical Power Transmission

A. AC as opposed to DC--DC cannot be transmitted over long distances without large power losses but AC can, so AC provides us with a clean, usable energy form that can be transmitted over extremely long or short distances.

B. Generating station--Point of origin for transmission of electrical power. There are many types of generating stations such as hydroelectric, coal burning, and nuclear. The voltages at these plants are stepped up extremely high before being transmitted.

C. Substation--Consists primarily of switching relays and transformers. Begins the voltage step-down process, with step-down transformers, and controls the distribution of the current. There may be several substations between a generating station and the consumer. (NOTE: As voltage is stepped up current is stepped down. The reverse is also true.)

D. Residential transformer--Transformer seen on utility poles near houses. This transformer completes the step down process to a usable level for a house: 240 volts are brought into the house via 3 wires. There are 2 "Hot" wires and 1 neutral. There are 240 volts across the 2 hot wires and 120 volts across 1 hot wire and the neutral.

E. Distribution panel--Often called the "Switch Box" or "Fuse Box", this panel is the point of origin for all the electrical circuits in the house.

VI. Uses of Electricity

A. Industrial--Discuss uses applicable to your area. Some general examples are: subway trains, industrial machinery, etc.

B. Residential--Discuss uses applicable to your area. Some general examples are: TV, toaster, doorbell, etc.

VII. Measuring Devices

A. Ammeter--(Demonstration #5) Device used for measuring current. Current is measured by hooking the meter in series with the circuit.

B. Voltmeter--(Demonstration #5) Device used for measuring voltage. Voltage is measured by hooking the meter in parallel with the circuit.

C. Ohmmeter--(Demonstration #5) Device for measuring resistance and can also be used for checking continuity. To measure resistance the component has to be out of the circuit.

D. VOM--(Demonstration #5) Volt-Ohm-Milliammeter. This device will measure current, voltage and resistance. It is all three meters in one.

E. Wattmeter--Special device for measuring power.

F. Kilowatt-hour meter--(Demonstration #6) This is the device on a house that the power company needs to determine how much electricity has been used.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheet and go through outline of material giving demonstrations as you go.

V. Discuss student activity sheets.

VI. Give test.

VII. Plan field trip to power station. (Suggested)

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Take field trip. (Suggested)

V. Take test.

REFERENCES/RESOURCES

I. References:

1. Miller, Rex, Communication: Electricity and Electronics, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.
2. Gerrish, Howard H.; Dugger, William E., Electricity and Electronics, South Holland, Ill.: Goodheart-Willcox Co., Inc. 1977.
3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, N.Y: McGraw-Hill, Inc. 1972.
4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hill, Inc. 1969, 2nd Ed.

II. Resources:

1. Information Sheets.
2. Transparency Masters.
3. Demonstrations.
4. Activity Sheets.

Information Sheet #1

Terms and Definitions:

Alternating current--Electrical current that changes direction of flow and magnitude with respect to time.

Ammeter--Device used to measure electrical current. It is connected in series with the circuit.

Ampere--Unit of measurement of electrical current. One ampere is equal to 6.25 x 10^{18} electrons flowing past a given point in one second, or 1 coulomb/second.

Atom--Smallest particle of an element that retains all the chemical properties of the element.

Battery--Two or more cells.

Cell--Device used to convert chemical energy to electrical energy.

Compound--Matter composed of two or more elements.

Conductor--Material through which electric current can flow easily due to its number of free electrons.

Conventional flow--Theory that states that electric current flows from positive to negative.

Coulomb--Physical unit of electrical charge. It is equal to the charge of 6.25 x 10^{18} electrons.

Current--The flow of electrons through a conducting material.

Direct current--Electrical current that does not change direction of flow with respect to time.

Electrode--Usually refers to the metal parts of a cell or battery.

Electrolyte--Solution that is able to conduct current usually in a cell or battery.

Electron--Smallest particle of negative charge.

Element--Variety of matter in which all atoms are the same.

Insulator--Opposite of a conductor. Provides a high resistance to current flow.

Lodestone--Iron ore that has been magnetized by the earth's magnetic field.

Ohm--Unit of measurement of resistance.

Ohmmeter--Device used to measure resistance in ohms.

Proton--Smallest particle of positive charge.

Resistance--Anything that opposes current flow is called resistance.

Solar cell--A type of photocell used to convert the energy of sunlight into electrical energy.

Static electricity--Electrical energy that is not in motion.

Thermocouple--Device made up of two dissimilar metals bound together at one end. When heated a difference in potential is produced across the two pieces of metal.

Transformer--Device used to step-up or step-down voltage.

Volt--Unit of measurement of voltage.

Voltage--Electromotive force or electrical pressure.

Voltmeter--Device for measuring voltage in volts.

VOM--Volt-Ohm-Milliammeter; device used to measure voltage, resistance and current.

Information Sheet #2

Electrical Shock

Let us look at the facts of electrical shock. The following data were compiled with the kind assistance of Dr. Pothoff of the National Safety Council, and the Pacific Telephone and Telegraph Company.

Type of Resistance	Resistance Values
Dry skin	100,000 to 600,000 ohms
Wet skin	1,000 ohms
Internal Body	
Hand-to-foot	400 to 600 ohms
Ear-to-ear	approximately 100 ohms

For example, with 120 volts and a skin resistance plus internal resistance totaling 1200 ohms, the result would be a current of 100 milliamperes. That much current is definitely enough to cause death:

The following data make a very clear and self-explanatory summary of the effects of various currents through the human body.

Safe Current Values

1 ma.:	Causes no sensation--not felt.
1 to 8 ma.:	Sensation of shock, but not painful; individual can release his contact at will, as muscular control is not lost.

Unsafe Current Values

8 to 15 ma.:	Painful shock; individual can let go at will. Control is not lost.
15 to 20 ma.:	Painful shock; muscular control of adjacent muscles lost. Cannot let go.
20 to 75 ma.:	Painful shock; severe muscular contractions with breathing extremely difficult.
100 to 200 ma.:	Painful shock, causing "ventricular fibrillation of the heart. This is irregular twitching of the wall of the ventricle of the heart. It is a fatal heart condition, for which there is no known remedy or resuscitation. It means DEATH."

Unsafe Current Values (cont'd)

200 ma. or over:	Severe burns, severe muscular contractions, so severe that chest muscular reaction clamps the heart and stops it for the duration of shock. This reaction prevents ventricular fibrillation. Artificial respiration should be administered immediately and in most cases the victim can be revived.

If skin contact in the circuit is maintained while the current flows through the skin, the actual skin resistance is gradually decreased.

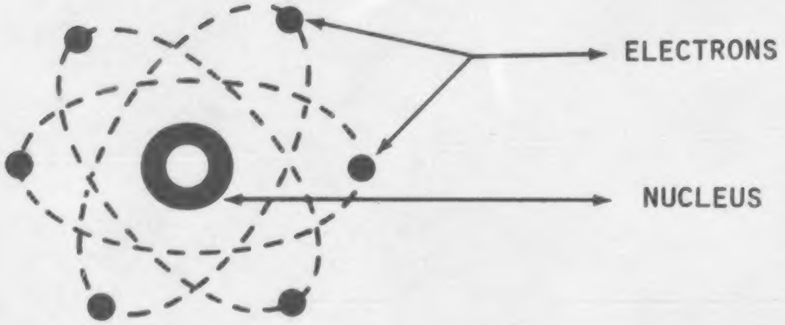
Remember this: Current is the filling factor in electrical shock. The voltage is important only in that it determines how much current will flow through a given body resistance. A voltage of 110-120 is enough to cause a current many times greater than that necessary to be fatal. Currents of 100 to 200 ma. cause a fatal heart condition known as ventricular fibrillation. There is no known remedy to prevent death in this condition. Artificial respiration proves ineffective in reviving victims receiving this amount of shock. It is a generally accepted fact that fewer low-voltage shock victims can be revived than those receiving shocks of 1000 volts or more. So remember this when you work around your equipment. Low voltage as well as high voltage can be lethal. Be careful--be extremely cautious--when working with or around electricity.

Information Sheet #3

Greek Prefixes

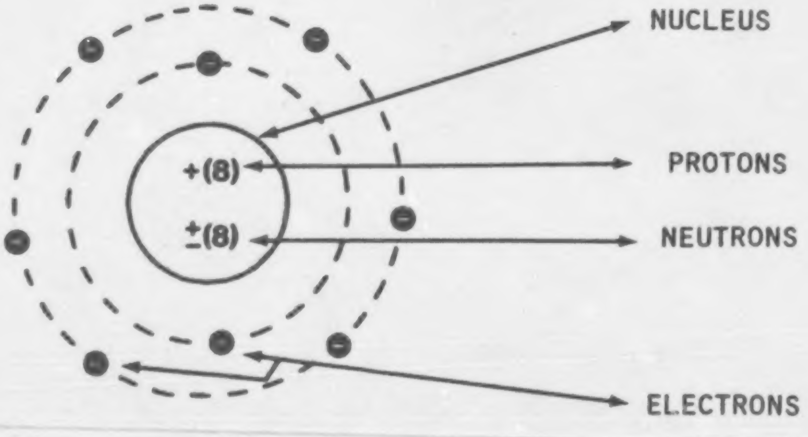
Prefix	Symbol	Numerical Equivalent
tera	T	10^{12} = 1,000,000,000,000
giga	G	10^{9} = 1,000,000,000
mega	M	10^{6} = 1,000,000
kilo	k	10^{3} = 1,000
hecto	h	10^{2} = 100
deka	da	10 = 10
deci	d	10^{-1} = .1
centi	c	10^{-2} = .01
milli	m	10^{-3} = .001
micro		10^{-6} = .000001
nano	n	10^{-9} = .000000001
pico	p	10^{-12} = .000000000001

ATOMIC STRUCTURE


ELECTRONS
NUCLEUS

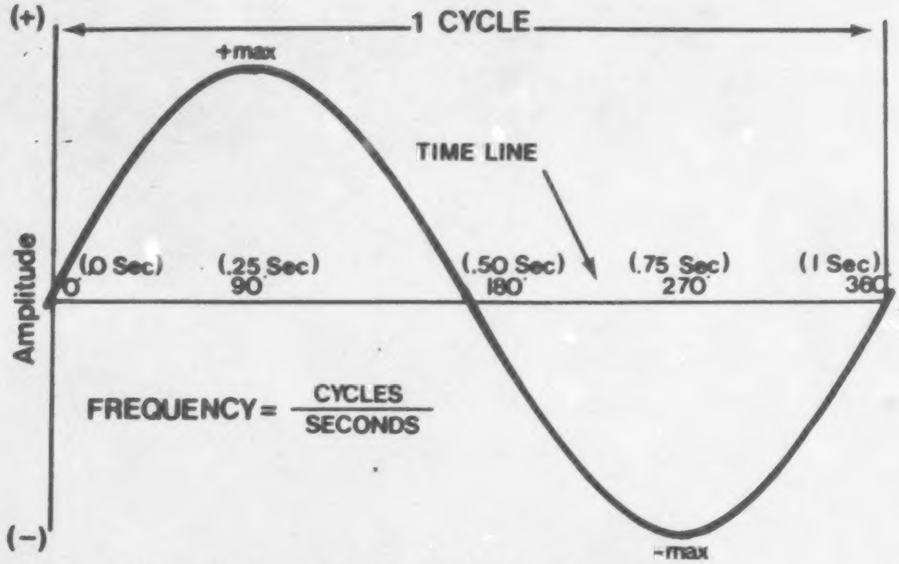
ATOM: PICTORIAL REPRESENTATION

OXYGEN
ATOMIC WEIGHT 16
ATOMIC NUMBER 8

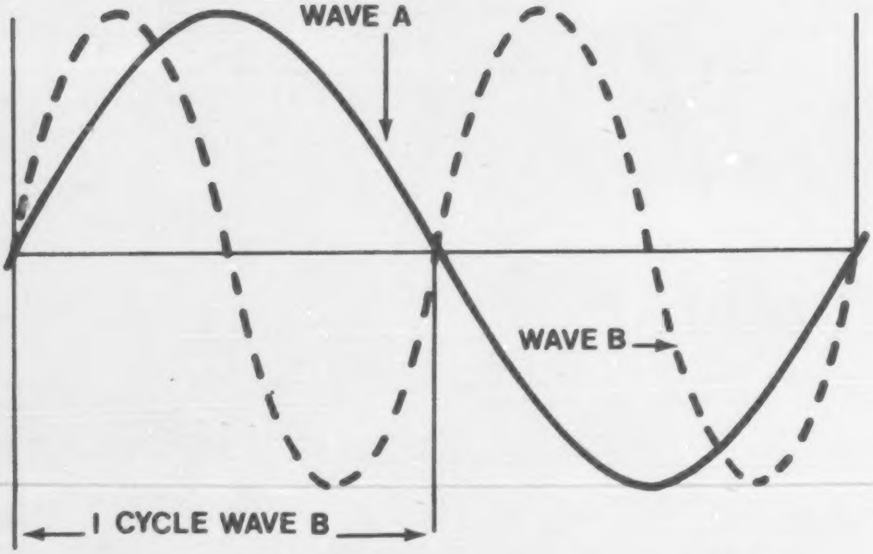

NUCLEUS
+(8)
±(8)
PROTONS
NEUTRONS
ELECTRONS

ATOM: SYMBOLIC REPRESENTATION

SINE WAVE

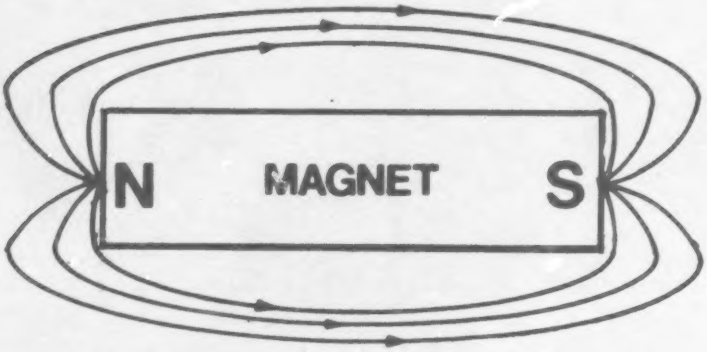

(+)
1 CYCLE
+max
TIME LINE
Amplitude
(0 Sec)
0°
(.25 Sec)
90°
(.50 Sec)
180°
(.75 Sec)
270°
(1 Sec)
360°
FREQUENCY = CYCLES / SECONDS
(–)
–max

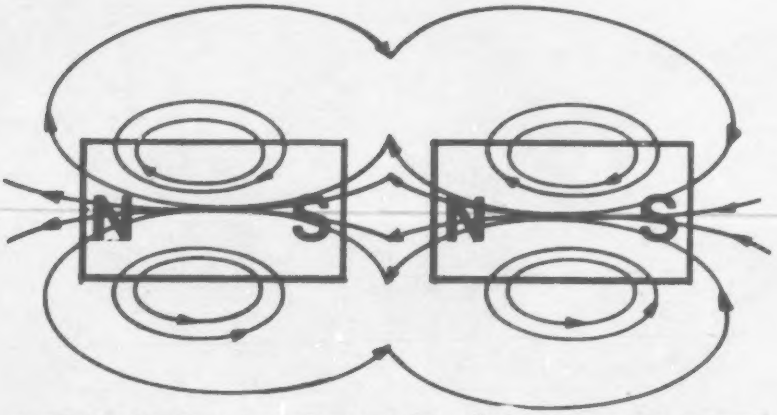
AC values for SINE WAVES


WAVE A
WAVE B
1 CYCLE WAVE B

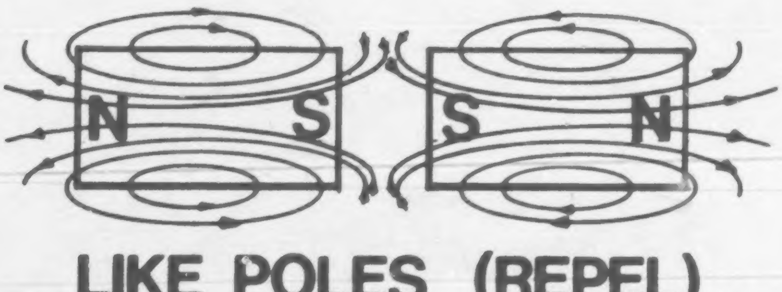
WAVE B is TWICE the frequency of WAVE A

MAGNETISM





UNLIKE POLES (ATTRACT)



LIKE POLES (REPEL)

MEASURING CURRENT & VOLTAGE

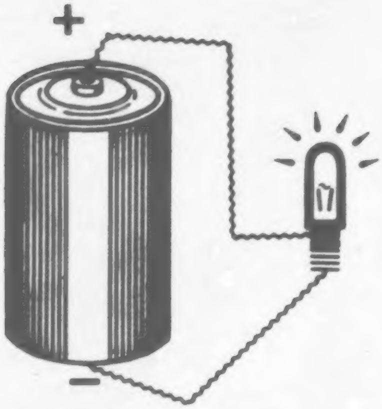


FIGURE 1

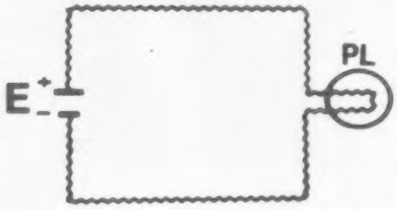


FIGURE 2

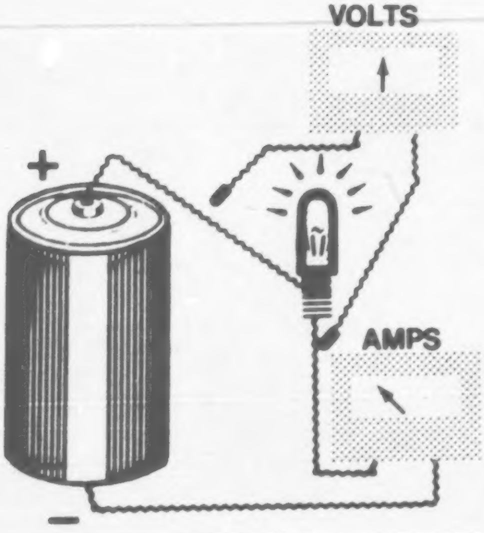


FIGURE 3

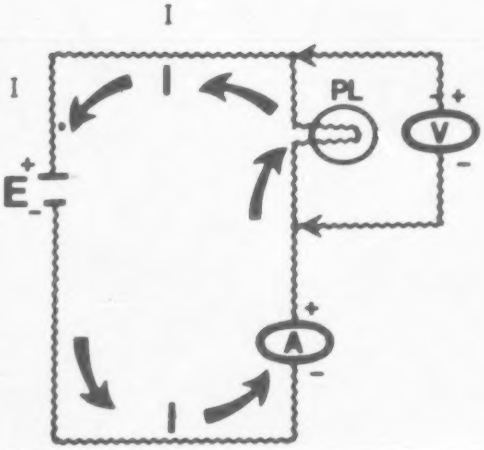


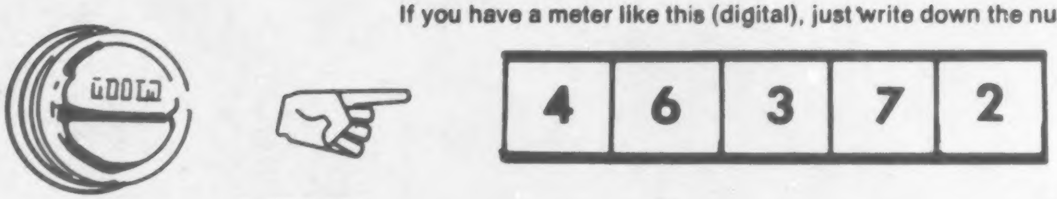
FIGURE 4

CURRENT (AMPS) IS MEASURED IN SERIES WITH THE CIRCUIT.

VOLTAGE (VOLTS) IS MEASURED IN PARALLEL WITH THE CIRCUIT.

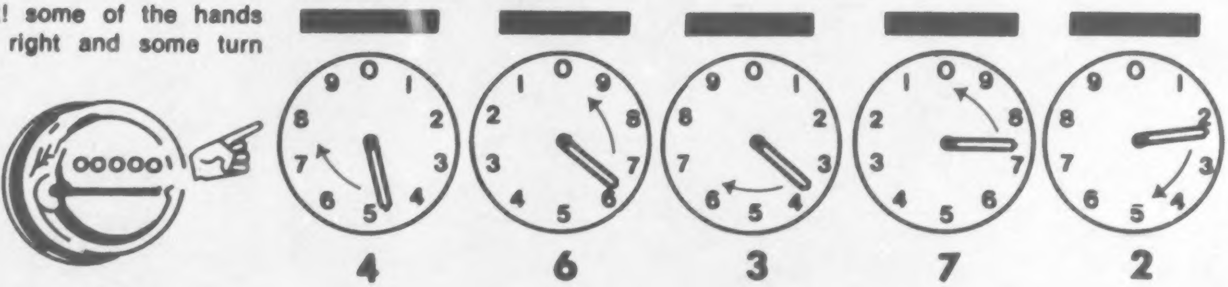
HOW TO READ THE WATT HOUR METER

If you have a meter like this (digital), just write down the numbers.



If your meter looks like this (dials), read the right one first. Write down the last number the hand has passed.

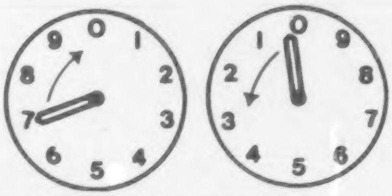
Look! some of the hands turn right and some turn left.



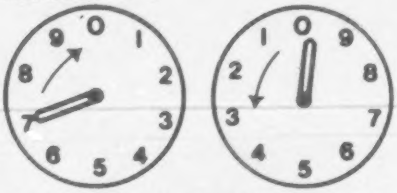
Take the last reading from the new reading.

46372	new reading
45109	last reading
1263	amount of kilowatthours you have used

This is the way to read a meter. But there is one more thing. If a hand is right on a number and you don't know if it has passed or not, then do this. Look at the dial to the right. Has the hand passed 0?



If this dial on the right *has passed 0*, write down the number the hand on the left is pointing to. In this case "7".



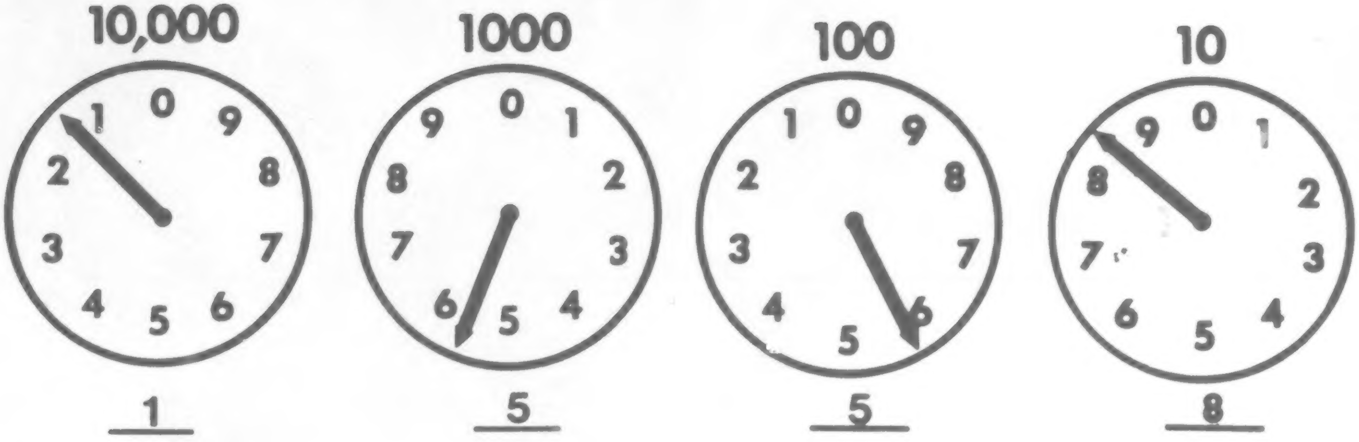
If the dial on the right has *not* passed 0, write down the number the dial on [illegible] left has just passed. In this case "6".

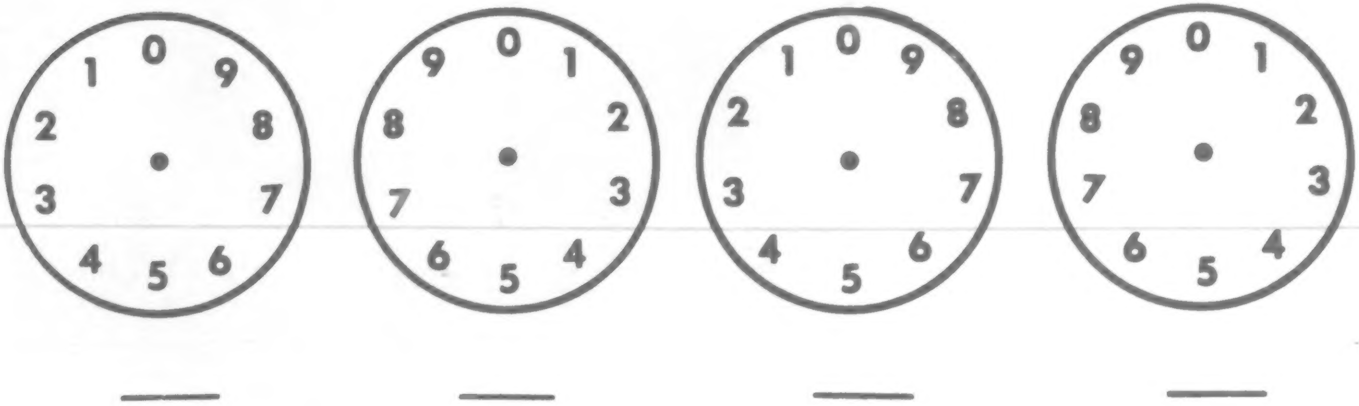
WEEK OF:	METER READING

prepared by Tennessee Valley Authority • Division of Power Utilization

Use Electricity Wisely

READING WATT HOUR METERS


10,000
1000
100
10
1
5
5
8



T.M.-6 / EE 2.16-F

Demonstration #1

Electrical Energy from Chemical Action

Apple Battery

Objective:

To produce electrical current from a chemical reaction using some very common materials: apples, pennies, and nickels.

Materials:

1. 2 apples
2. 2 pennies
3. 2 nickels
4. 1 jumper wire with clips
5. 1 microammeter with leads
6. 1 razor blade or equivalent sharp object

Procedure:

1. Make 2 half inch slits in each apple. The slits should be opposite each other on the apple.
2. Insert 1 penny and 1 nickel into each apple.
3. Connect the jumper wire between the penny on one apple and the nickel on the other apple.
4. Connect the leads of the microammeter to the remaining coins.
5. Read the meter. (Note: if the meter deflects off scale, reverse the microammeter leads.)

Principle:

The acetic acid in the apple combines with the nickel to form nickel ions and hydrogen gas. The nickel ions are nickel molecules that have lost 2 electrons thus they are positively charged and the hydrogen gas is hydrogen atoms that have gained these electrons, thus they are negatively charged. It is this reaction that provides the ions and free electrons for current flow. The penny acts only as an inert electrode.

Demonstration #2

Electrical Energy from Heat

Objective:

To construct a simple thermocouple and generate an electrical current.

Materials:

1. 2 - 12" pieces (#14 or larger) of two different types of wire (ex: copper and aluminum)
2. 1 milliammeter with leads
3. 1 pair of pliers
4. 1 heat source (a cigarette lighter will suffice)

Procedure:

1. If wire has insulation, strip it off completely.
2. Use the pliers and twist approximately 6" of the 2 wires together tightly.
3. Spread the opposite ends apart at about a 45° angle. (You now have a thermocouple)
4. Connect the leads of the milliammeter to the spread end of the thermocouple.
5. Using the pliers, hold the thermocouple at the beginning of the twist and heat the twisted end.
6. Read the meter (Note: if the meter deflects off scale, reverse the milliammeter leads.)

Principle:

As the thermocouple is heated, electrons are forced to move from one wire to the other wire. As a result one becomes more negtive and the other more positive and a difference in potential is created. It is this difference in potential that produces current flow.

Demonstration #3

Electrical Energy from Sunlight

Objective:

To produce electricity from sunlight using a simple solar cell.

Materials:

1. 1 solar cell (Calectro #J4-804 or equivalent--under $10.00)
2. 1 VOM or voltmeter

Procedure:

1. Mount the solar cell on a small board for handling purposes.
2. Place the solar cell in direct sunlight. (outside or near a window)
3. Connect the leads of the VOM to the terminals of the solar cell.
4. Read the meter. (Note: if the meter deflects off scale, reverse the VOM leads)
5. Cover the solar cell with something that will block all light. (a piece of black construction paper will work)
6. Repeat step #4.
7. If funds are available, buy several and construct a solar battery.

Principle:

When the sunlight strikes the solar cell, electrons are driven from one material across a barrier to another material. This causes a difference in potential to develop between the two materials. This voltage will provide for current flow.

Demonstration #4

Magnetism

Objective:

To determine the basic laws and principles of magnetism.

Materials:

1. 2 bar magnets
2. 1 small bottle of iron filings
3. 25 feet of bell wire
4. 1 piece of 3/8" steel rod or bolt, 4" long
5. 1 dry cell battery, 6 volts
6. 1 SPST pushbutton switch (any SPST switch will work)
7. 1 piece of heavy white paper (ex: construction paper)
8. 2 or 3 ferrous objects (screws, nuts, washers, etc.)
9. 2 or 3 non-ferrous objects (penny, plastic item, aluminum item)
10. 1 roll of plastic electrical tape.

Procedure #1:

1. Using 1 bar magnet attempt to pick up some ferrous objects.
2. Using 1 bar magnet attempt to pick up some non-ferrous objects.

Principle #1:

Only ferrous metals are attracted by a magnet.

Procedure #2:

1. Attempt to push the north poles of both bar magnets together.
2. Attempt to push the south poles of both bar magnets together.
3. Attempt to push north pole of 1 bar magnet and the south pole of the other bar magnet together.
4. Lay the bar magnets side by side with the north poles beside each other and the south poles beside each other.
5. Lay the bar magnets side by side with the north pole of one beside the south pole of the other.

Demonstration #3

Electrical Energy from Sunlight

Objective:

To produce electricity from sunlight using a simple solar cell.

Materials:

1. 1 solar cell (Calectro #J4-804 or equivalent--under $10.00)
2. 1 VOM or voltmeter

Procedure:

1. Mount the solar cell on a small board for handling purposes.
2. Place the solar cell in direct sunlight. (outside or near a window)
3. Connect the leads of the VOM to the terminals of the solar cell.
4. Read the meter. (Note: if the meter deflects off scale, reverse the VOM leads)
5. Cover the solar cell with something that will block all light. (a piece of black construction paper will work)
6. Repeat step #4.
7. If funds are available, buy several and construct a solar battery.

Principle:

When the sunlight strikes the solar cell, electrons are driven from one material across a barrier to another material. This causes a difference in potential to develop between the two materials. This voltage will provide for current flow.

Demonstration #4

Magnetism

Objective:

To determine the basic laws and principles of magnetism.

Materials:

1. 2 bar magnets
2. 1 small bottle of iron filings
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4. 1 piece of 3/8" steel rod or bolt, 4" long
5. 1 dry cell battery, 6 volts
6. 1 SPST pushbutton switch (any SPST switch will work)
7. 1 piece of heavy white paper (ex: construction paper)
8. 2 or 3 ferrous objects (screws, nuts, washers, etc.)
9. 2 or 3 non-ferrous objects (penny, plastic item, aluminum item)
10. 1 roll of plastic electrical tape.

Procedure #1:

1. Using 1 bar magnet attempt to pick up some ferrous objects.
2. Using 1 bar magnet attempt to pick up some non-ferrous objects.

Principle #1:

Only ferrous metals are attracted by a magnet.

Procedure #2:

1. Attempt to push the north poles of both bar magnets together.
2. Attempt to push the south poles of both bar magnets together.
3. Attempt to push north pole of 1 bar magnet and the south pole of the other bar magnet together.
4. Lay the bar magnets side by side with the north poles beside each other and the south poles beside each other.
5. Lay the bar magnets side by side with the north pole of one beside the south pole of the other.

Principle #2:

Like poles repel each other and unlike poles attract each other.

Procedure #3:

1. Place the bar magnet on a flat surface.
2. Hold the piece of white paper above the magnet allowing it to barely touch the magnet.
3. Sprinkle the iron filings on the paper above the magnet.
4. Note the way the filings arrange themselves.

Principle #3:

The flux lines of a magnet are concentrated around the poles of the magnet.

Procedure #4:

1. Wind the bell wire tightly around the rod or bolt. Make at least 5 layers of wire and leave about 1/4" of each end of the rod or bolt exposed. Leave a 2 ft length of wire (for connection purposes) before you begin to wind the layers.
2. Wrap the finished coil with electrical tape.
3. Cut about 2 feet off at the long end of the bell wire.
4. Connect the piece of wire from step #3 to one side of the switch and one terminal of the battery.
5. Now connect one of the lead wires from the rod or bolt to the remaining side of the battery and connect the other lead to the remaining side of the switch.
6. With the switch in the open position attempt to pick up a ferrous object.
7. Now, close the switch and attempt to pick up a ferrous object. (You now have an electromagnet.)
8. While holding a ferrous object in the air with the magnet, open the switch and note what happens.
9. Steps 6 and 7 may be repeated with non-ferrous objects if desired.

Principle #4:

Anytime current flows through a conductor, a magnetic field is set up around that conductor. If the conductor is wound into a coil the magnetic field is concentrated inside the coil. If a piece of ferrous material is placed inside the coil as a core, a strong magnetic field will be concentrated in the core. As long as current flows, the magnetic field will remain strong, but if current flow is stopped only residual magnetism will remain in the core material.

Demonstration #5

VOLT-OHM-MILLIAMMETER

Objective:

To measure resistance, voltage and DC current with a VOM.

Materials:

1. 1 VOM
2. 5 resistors of various values
3. 1 AC voltage source (wall receptacle will suffice)
4. 1 DC voltage source (6V dry cell battery will suffice)
5. 1 SPST switch
6. Hookup wire with clips (2 pieces)

Procedure:

A. Resistance
   1. Discuss ohms ranges
   2. Measure the resistance of the five resistors

B. Voltage (AC)
   1. Discuss AC voltage ranges
   2. Connect the VOM in parallel with the source and measure AC voltage.

C. Voltage (DC)
   1. Discuss DC voltage ranges
   2. Connect the VOM in parallel with the source and measure DC voltage.

D. Current (DC)
   1. Discuss DC current ranges
   2. Construct a simple series circuit with a 6 volt DC source and a 24 ohm resistor.
   3. Connect the VOM in series with the circuit and measure DC current. (should read 250 ma.)

Demonstration #6

Reading a Power Meter

Objective:

To show the proper method for reading a kilowatt-hour meter.

Materials:

1. Transparency #7
2. Transparency #8
3. 1 kilowatt-hour meter (if available)

Procedure:

1. Place transparency #7 on the overhead projector.
2. Go through and explain the information on transparency #7.
3. Place transparency #8 on the overhead projector with the numbered blanks covered.
4. Ask the students to read the meter and write down their answer.
5. Uncover the numbers and discuss any wrong answers.
6. Draw pointers on the bottom set of dials and ask the students to read them.
7. Write in the correct answer and discuss any wrong answers.
8. Repeat steps #7 and 8 as often as desired.

Student Activity #1

Measuring Electricity

Objective:

You will take the VOM and select the proper settings and ranges and measure AC and DC voltage, current, and resistance.

Materials:

1. 1 VOM
2. 1 DC power supply or a 6 volt dry cell battery with terminals or holder
3. 2 1/4 watt resistors; 1-200 ohms and 1-20 ohms
4. 2 resistors any size and value
5. 2 test leads with clips on each end
6. 1 SPST switch

Procedure (Measuring AC voltage):

1. Using the VOM select the proper settings to measure the AC voltage in a wall receptacle.
2. Insert one test probe into one side of the receptacle and the other test probe into the other side of the receptacle.
3. Read the meter.

Procedure (Measuring DC voltage):

1. Using the VOM, select the proper settings to measure DC voltage.
2. Connect the test leads to the DC source (provided by the teacher).
3. Read the meter (if the meter deflects off scale, reverse the leads).

Procedure (Measuring Current):

1. Using 1 of the test leads, connect the positive terminal of a 6 volt DC source (provided by the teacher) to one side of the 200 ohm resistor.
2. Using the other test lead, connect the remaining side of the 200 ohm resistor to one side of the SPST switch. (Switch should be in the "OFF" position).

3. Now connect the negative lead of the VOM to the negative terminal of the DC source and connect the positive lead of the VOM to the remaining side of the switch.

4. Turn the switch to the "ON" position.

5. Read the meter.

6. Using the 300 ohm resistor repeat steps 1-5.

Procedure (Measuring Resistance):

1. Using the VOM select the proper settings and ranges for measuring resistance.

2. Using a resistor of unknown value, supplied by the teacher, connect one lead from the VOM to one end of the resistor and the other lead to the other end.

3. Read the meter.

4. Repeat steps 1-3 using as many resistors as the teacher gives you.

Student Activity #2

Building an Electromagnet

Objective:

You will construct an electromagnet from materials supplied by the teacher after which you will compete with other students to determine which electromagnet will pick up the most paper clips.

Materials:

1. 1 - 16d nail
2. 3 ft. - bell wire
3. 1 - 6 volt dc power source (dry cell is OK)
4. 1 box - paper clips

Procedure

1. Wind the wire around the nail leaving 6" of each end of the wire exposed.
2. Scrape the insulation off of 1" of each end of the wire.
3. Attach the wire ends to the terminals of the six volt source.
4. You now have an electromagnet.
5. Pick up paper clips with the electromagnet.
6. Count and record the number of clips that your electromagnet held.

Principle

Anytime current flows through a conductor, a magnetic field is set up around that conductor. If the conductor is wound into a coil the magnetic field is concentrated inside the coil. If a piece of ferrous metal is placed inside the coil as a core the magnetic field will be concentrated inside the core. As long as a current flows, the magnetic field will remain strong, but if current is stopped only residual magnetism will remain in the core material.

Student Activity #3

Observing Power Consumption

Objective:

You will read and record the values on the electrical power meter at your home.

Materials:

1. 1 pencil
2. 1 piece of paper

Procedure:

1. Read the kilowatt-hour meter at your home at the same time of day for seven days straight.
2. Record the values on your piece of paper.
3. Make a simple graph showing power usage for the seven day period.

Optional Procedure:

Repeat the above procedure for a 1 month period of time.

SUGGESTED TEST

Matching:

_____ 1. Provides a high resistance to current flow.

_____ 2. Smallest particle of negative charge.

_____ 3. Flow of electrons through a conducting material.

_____ 4. 6.25 x 10_{18} electrons.

_____ 5. Solution that is able to conduct current.

A. Current

B. Electrolyte

C. Electron

D. Coulomb

E. Insulator

True or False:

T F 6. A thermocouple is an example of a chemical source of electricity.

T F 7. Piezoelectric has to do with getting electrical energy from the sun.

T F 8. A lodestone is a natural magnet.

T F 9. Household wall current is enough to kill if the conditions are right.

T F 10. An ammeter measures voltage.

T F 11. The atom is the smallest unit of an element.

T F 12. One ampere is equal to one coulomb per second.

T F 13. Friction causes static electricity.

T F 14. The unit of measurement for resistance is the ohm.

T F 15. 100 to 200 ma. of current produces ventricular fibrillation and is fatal.

ANSWERS TO TEST

1. E
2. C
3. A
4. D
5. B
6. F
7. F
8. T
9. T
10. F
11. T
12. T
13. T
14. T
15. T

EQUIPMENT/SUPPLIES

Equipment:

1. 1 microammeter
2. 1 milliammeter
3. 1 pair pliers
4. 1 heat source (cigarette lighter will suffice)
5. 1 solar cell (Calectro #J4-804 or equivalent—under $10.00, 1979)
6. 2 bar magnets
7. 1 kilowatt-hour meter (if available)
8. 24 VOM meters
9. 24 DC power sources or 6 volt dry cell batteries
10. 48 test leads with clips on each end
11. 24 SPST switches

Supplies:

1. 2 apples
2. 2 pennies
3. 2 nickels
4. 1 razor blade or equivalent sharp object
5. 2 12" pieces (#14 or larger) of 2 different types of wire (ex: copper and aluminum)
6. 1 small bottle of iron filings
7. 100 feet bell wire
8. 1 piece of 3/8" steel rod or bolt, 4" long
9. 1 roll of plastic electrical tape
10. 24 1/4 watt 200 ohm resistors
11. 24 1/4 watt 20 ohm resistors
12. 48 resistors of any size and value

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

ELECTRONICS

DESCRIPTION OF UNIT

This unit will cover basic electronic concepts. It will give an overview of the following areas: electronic components (such as resistors, capacitors, inductors and solid state devices), electronic calculations, and basic circuit analysis. The materials in this unit are designed for 10 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify electronic terms and definitions, list and describe basic electronic components, perform basic electronic calculations and analize simple circuits.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given electronic terms to the correct definition or description.
2. List and describe 6 electronic components.
3. Demonstrate the ability to:
    A. Perform basic electronic calculations.
    B. Analize simple circuits.

OUTLINE OF CONTENT

I. Components

A. Resistor--A resistor is an electronic component used to add resistance to a circuit. (Remember that resistance is an opposition to current flow.) Although resistors come in a variety of types, sizes and shapes they all do the same thing; they resist current flow. Resistors are rated two ways: 1) value in ohms, and 2) power rating.

1. Ohms rating--The resistance value (in ohms) is marked on resistors in one of two ways: 1) a standard color code, and 2) numbers stamped on the resistor.

2. Power rating--There are two ways the power rating of resistors can be determined. One way is the physical size of the resistor and the other way is reading the value stamped on the resistor.

3. Types--There are many types of resistors. Some are general purpose while others are designed for more specific applications. The most common type is the carbon composition resistor. Some others are the wirewound, metal-glaze, and glass-tin oxide.

4. Fixed resistor--A fixed resistor is a resistor with a fixed or constant value.

5. Variable resistor--A variable resistor is a resistor which is adjustable.

B. Inductors--Inductors are coils of wire of various sizes and are used to add inductance to the circuit.

1. Inductance--Inductance is the property in a circuit that opposes a change in current. It is present only when AC current is used.

2. Fixed inductor--An inductor in which the inductance is constant.

3. Variable inductor--An inductor the value of which is adjustable.

4. Unit of measurement--The henry.

C. Capacitors—Capacitors are made up of two pieces of a conducting material separated by an insulating material called a dielectric. They are used to add capacitance to a circuit.

1. Capacitance--Capacitance is the property in a circuit that opposes a change in voltage.
2. Plate--One of the pieces of conducting material in a capacitor.
3. Dielectric--The insulating material between the plates.
4. Fixed capacitor--A capacitor in which the capacitance is constant.
5. Variable capacitor--A capacitor the capacitance of which can be adjusted.
6. Unit of measurement--The Farad usually measured in microfarads.

D. Electron Tube--A hermetically sealed glass or metal envelope in which conduction of electrons takes place through a vacuum or gas. Although they are obsolete for the most part, being replaced by solid state devices, their primary function is amplification.

1. Cathode--Common name for the negative electrode of a vacuum tube.
2. Anode--Common name for the positive electrode (or plate) of a vacuum tube.
3. Grid--An electrode having one or more openings for the passage of electrodes or ions. One or more grids are used in electron tubes to control the flow of electrons.
4. Diode Tube--The electron tube having two electrodes, a cathode and an anode.
5. Triode Tube--Electron tube having an anode, a cathode, and a control grid.

   (Note: As tubes get larger, tetrode, pentode, etc., there are simply more control grids added)

E. Transistor--The transistor is a solid state (or semiconductor) device that has effectively almost totally replaced the electron tube. The transistor has 3 or more electrodes. The three main electrodes used are the emitter, base, and collector. Transistors do not heat up like tubes and this makes them more efficient.

F. Integrated circuit (IC)--Developed in 1958 at Texas Instruments the integrated circuit is a total electronic circuit housed in one very small unit.

II. Calculations

A. Ohms Law--One of the fundamental laws of electronics, Ohm's Law is stated: The current in amperes in a circuit is equal to the applied voltage divided by the resistance

$$I = \frac{E}{R}$$ (See Transparency Master)

B. Watt's Law--One watt of electrical power is equal to one volt moving one coulomb of charge in one second.

$$P = I \times E$$ (See Transparency Master)

III. Circuit Analysis

A. Series Circuits

1. Batteries--The total output voltage of batteries connected in a series circuit is the sum of the output voltages of all the individual batteries. (See Transparency Master)

2. Resistors--The total resistance of a series circuit is equal to the sum of all the individual resistors.

The formula is: $R_T = R_1 + R_2 = R_3 = R_n \ldots.$

where: R_T = Total resistance in ohms for the circuit

R_1 = Value in ohms for the 1st resistor

R_2 = Value in ohms for the 2nd resistor

R_3 = Value in ohms for the 3rd resistor

R_n = Value in ohms for each of any number of resistors

B. Parallel circuits

1. Batteries--The output voltage of batteries connected in a parallel circuit is the same as the output of each of the individual batteries, but the available current is increased. (NOTE: Batteries of unequal value should not be connected in parallel as damage may result.)

2. Resistors--The total resistance of a parallel circuit is equal to the reciprocal of the sum of the reciprocals of each individual resistor.

The formula is:

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_n}}$$

where: R_T = Total value of resistance in ohms for the whole circuit

R_1 = Value in ohms for the 1st resistor

R_2 = Value in ohms for the 2nd resistor

R_3 = Value in ohms for the 3rd resistor

R_n = Value in ohms for each of any number of resistors

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheet and go through outline of material giving demonstrations as you go.

V. Discuss student activity and assignment sheets.

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Complete assignment sheets.

REFERENCES/RESOURCES

References:

1. Miller, Rex, Communication: Electricity and Electronics, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.
2. Gerrish, Howard H.; Dugger, William E., Electricity and Electronics, South Holland, Ill.: Goodheart-Wilcox Co., Inc. 1977.
3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, New York: McGraw-Hill, Inc. 1972.
4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hall, Inc. 1969, 2nd Ed.

Resources:

1. Information Sheets
2. Transparency Masters
3. Demonstrations
4. Activity Sheets

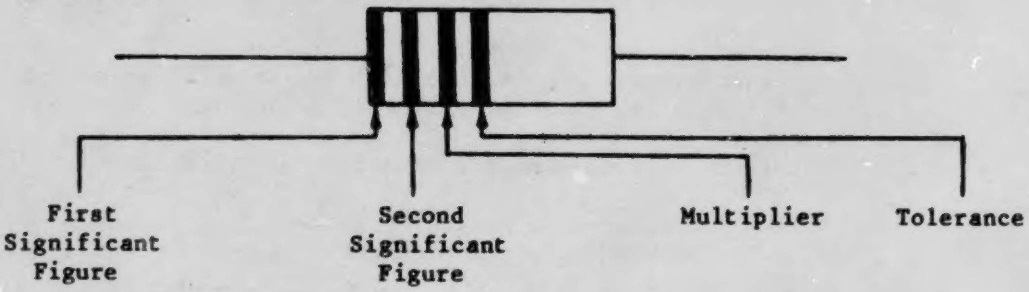
EE 3.9

Information Sheet #1

Terms and Definitions:

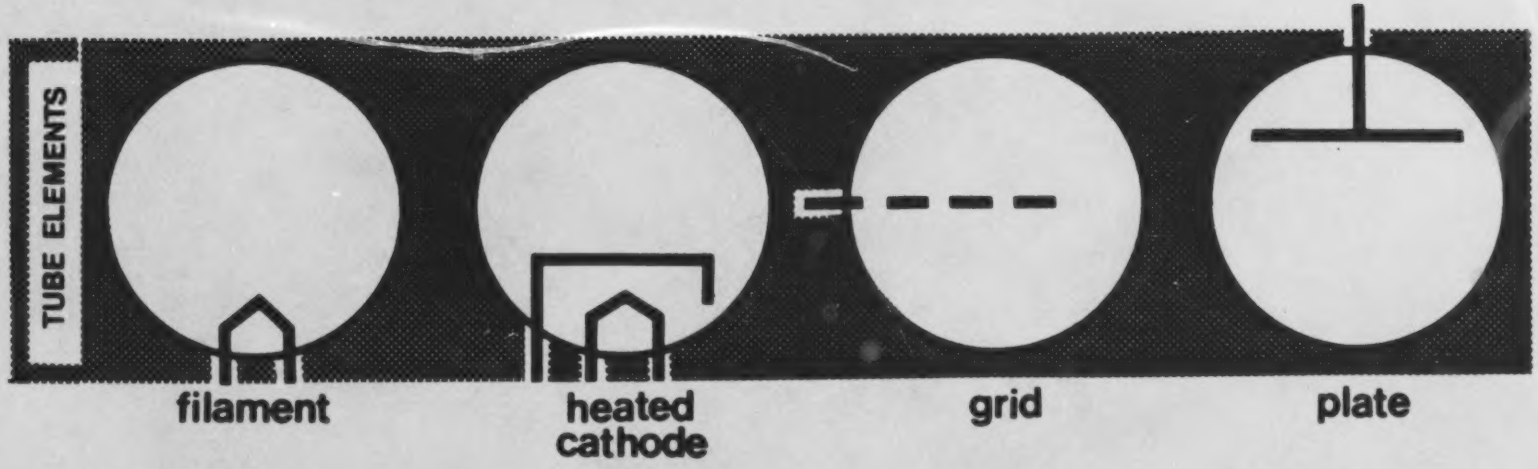
1. Anode--Common name for a positive electrode.
2. Capacitance--Property of a capacitor to oppose a change in voltage.
3. Capacitor--Two pieces of conducting material separated by a piece of insulating material called a dielectric.
4. Cathode--Common name for a negtive electrode.
5. Electron tube--A hermetically sealed glass or metal envelope in which the conduction of electrons takes place through a vacuum or gas.
6. Farad--Unit of measurement for capacitance.
7. Fixed capacitor--A capacitor whose value cannot be changed.
8. Fixed inductor--An inductor whose value cannot be changed.
9. Fixed resistor--A resistor whose value cannot be changed.
10. Henry--Unit of measurement for inductance.
11. Inductor--Coil of wire used to add inductance to a circuit.
12. Inductance--Property of an inductor that opposes a change in current.
13. Ohm--Unit of measurement of resistance.
14. Potentiomer--Variable resistor used to control voltage.
15. Resistance--Anything that opposes current flow.
16. Resistor--Device for adding resistance to a circuit.
17. Variable capacitor--Capacitor the capacitance of which can be changed or varied.
18. Variable inductor--Inductor the inductance of which can be changed or varied.
19. Variable resistor--Resistor whose value can be changed or varied.
20. Watt--Unit of measurement of electrical power.

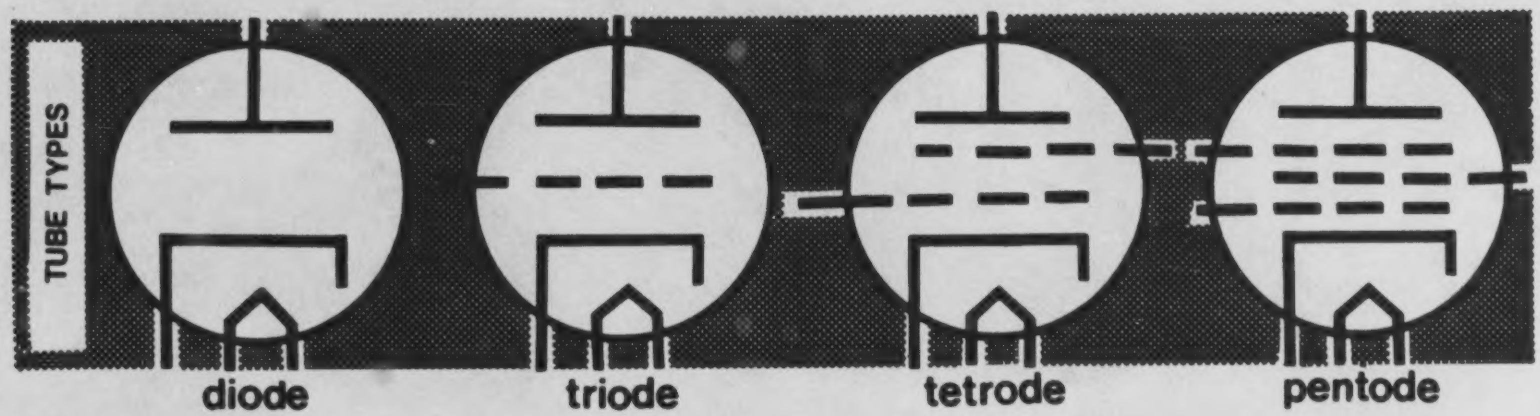
RESISTOR COLOR CODE


First Significant Figure
Second Significant Figure
Multiplier
Tolerance

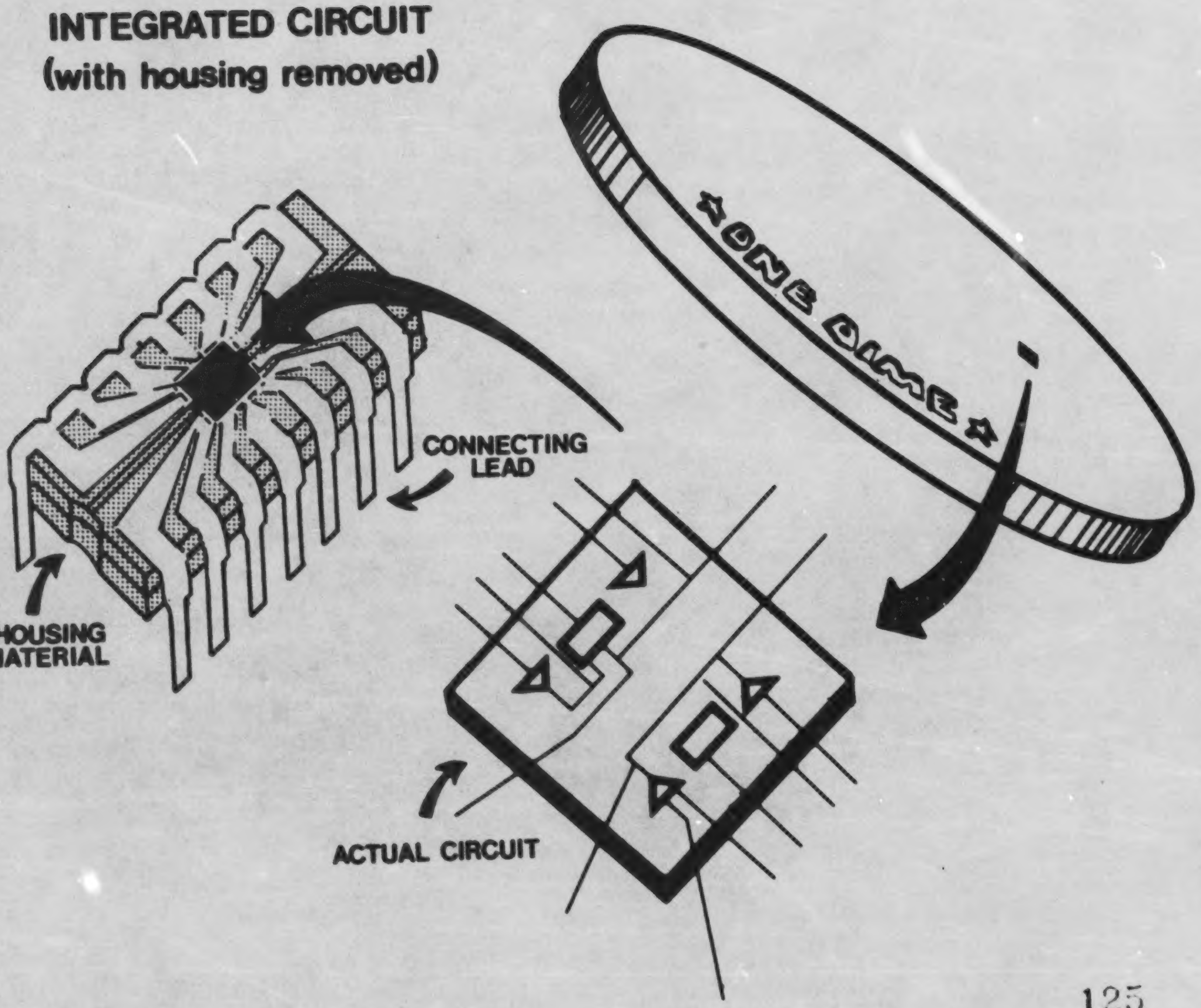
COLOR	DIGIT	MULTIPLIER	TOLERANCE	ACRONYM
Black	0	1	---	Bad
Brown	1	10	---	Boys
Red	2	100	---	Rob
Orange	3	1,000	---	Our
Yellow	4	10,000	---	Young
Green	5	100,000	---	Girls
Blue	6	1,000,000	---	Behind
Violet	7	10,000,000	---	Victory
Gray	8	100,000,000	---	Garden
White	9	1,000,000,000	---	Walls
Gold		.1	± 5%	
Silver		.01	± 10%	
No Color			± 20%	

VACUUM TUBE SYMBOLS

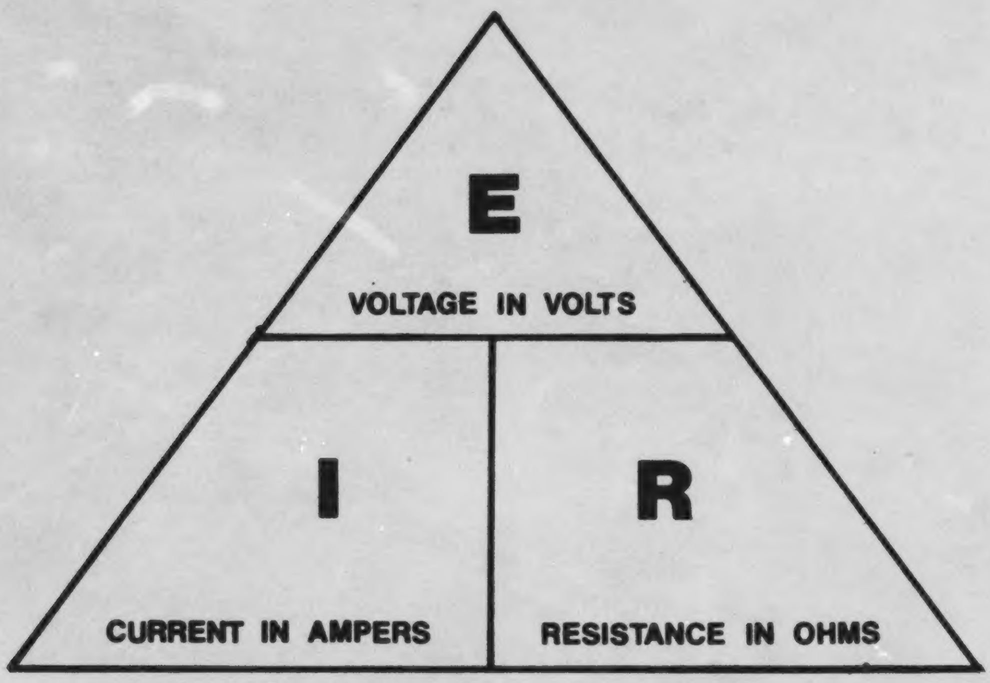

TUBE ELEMENTS
filament
heated cathode
grid
plate


TUBE TYPES
diode
triode
tetrode
pentode

INTEGRATED CIRCUIT
(with housing removed)


★ONE DIME★
CONNECTING LEAD
HOUSING MATERIAL
ACTUAL CIRCUIT

OHM'S LAW


E
VOLTAGE IN VOLTS
I
CURRENT IN AMPERS
R
RESISTANCE IN OHMS

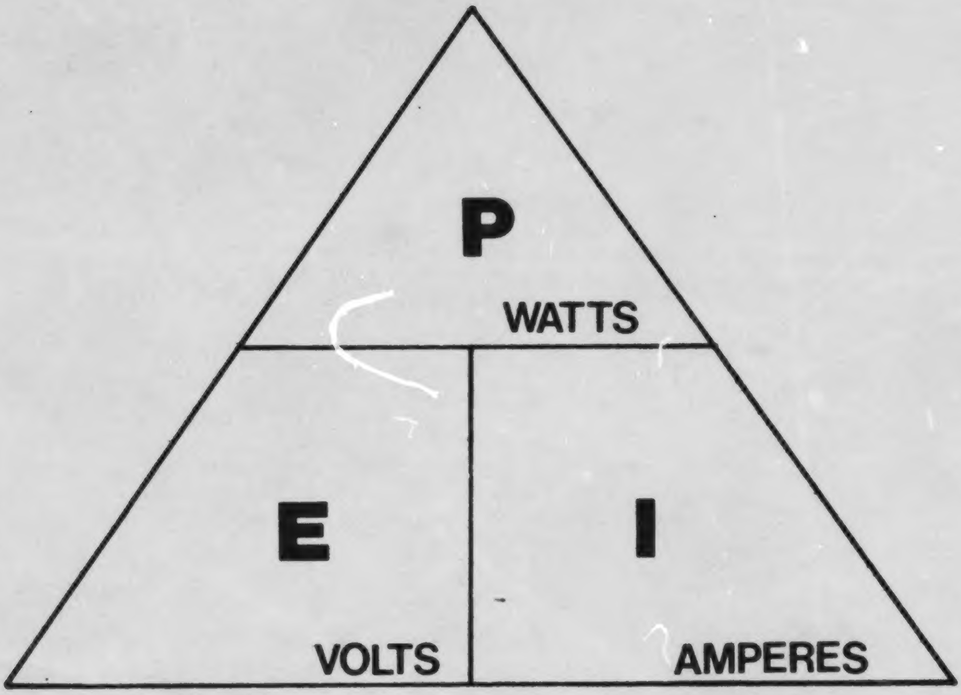
E	VOLTAGE	VOLTS
I	CURRENT	AMPERES
R	RESISTANCE	OHMS

$$E = I \cdot R$$

$$I = \frac{E}{R}$$

$$R = \frac{E}{I}$$

POWER · WATT'S LAW


P
WATTS
E
VOLTS
I
AMPERES

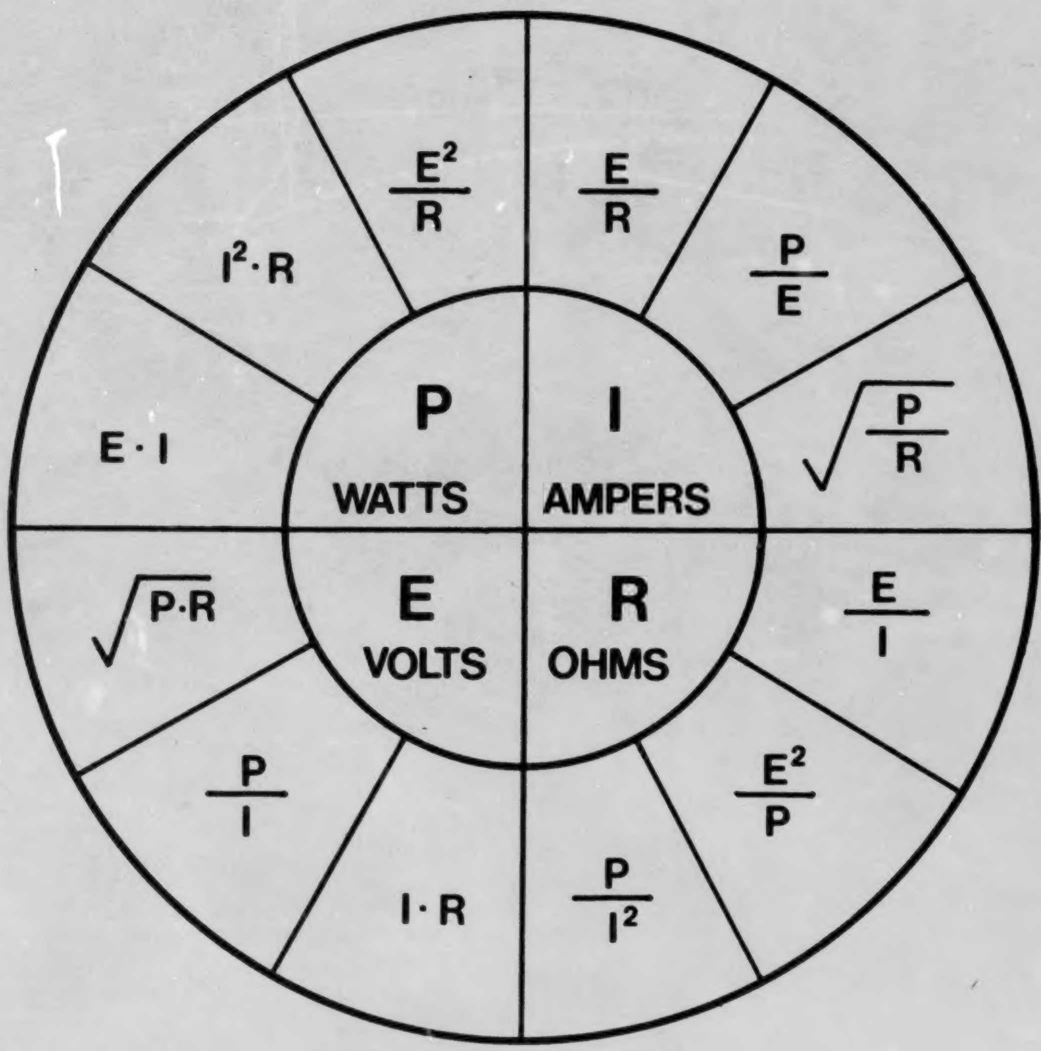
$$E = I \cdot R \qquad I = \frac{E}{R} \qquad R = \frac{E}{I}$$

$$E = \frac{P}{I} \qquad I = \frac{P}{E} \qquad R = \frac{E^2}{P}$$

$$E = \sqrt{P \cdot R} \qquad I = \sqrt{\frac{P}{R}} \qquad R = \frac{P}{I^2}$$

$$P = E \cdot I \qquad P = I^2 \cdot R \qquad P = \frac{E^2}{R}$$

OHM'S LAW & WATT'S LAW RELATIONSHIPS


$\frac{E^2}{R}$
$\frac{E}{R}$
$I^2 \cdot R$
$\frac{P}{E}$
P
I
WATTS
AMPERS
$E \cdot I$
$\sqrt{\frac{P}{R}}$
$\sqrt{P \cdot R}$
E
R
VOLTS
OHMS
$\frac{E}{I}$
$\frac{P}{I}$
$\frac{E^2}{P}$
$I \cdot R$
$\frac{P}{I^2}$

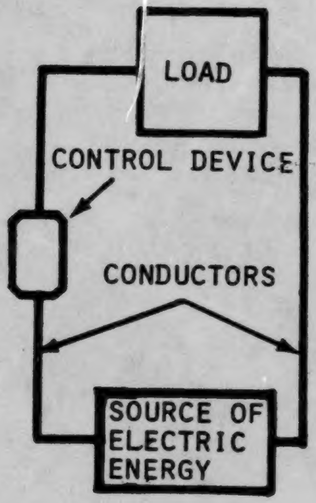
E = VOLTAGE

R = RESISTANCE

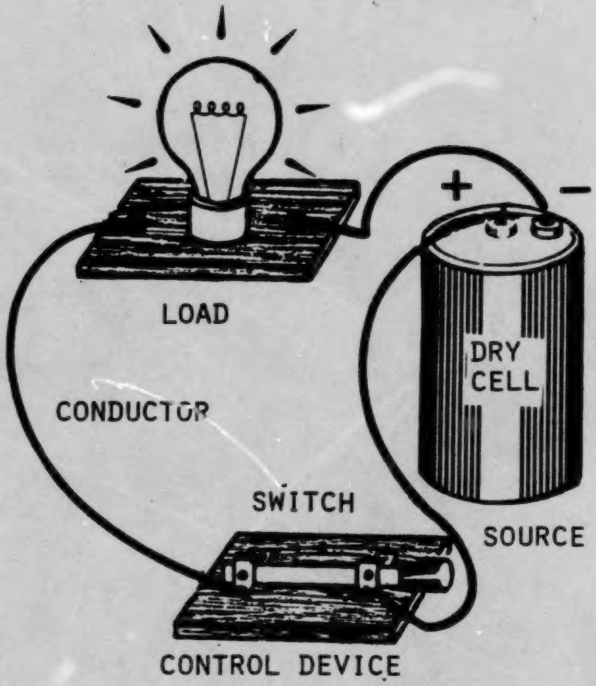
I = CURRENT

P = POWER

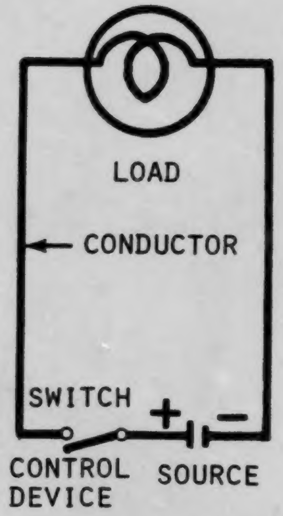
ELECTRIC CIRCUIT


LOAD
CONTROL DEVICE
CONDUCTORS
SOURCE OF ELECTRIC ENERGY

BLOCK DIAGRAM


+
−
LOAD
DRY CELL
CONDUCTOR
SWITCH
SOURCE
CONTROL DEVICE

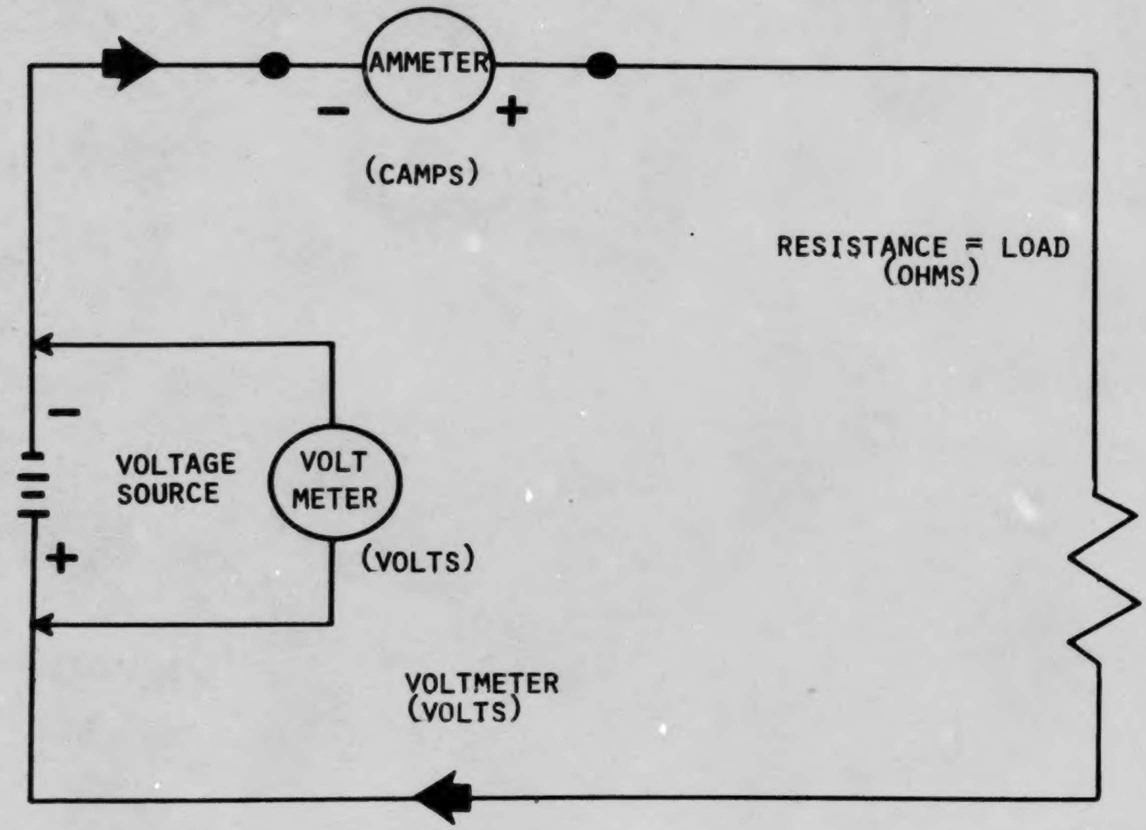
PICTORIAL DIAGRAM


LOAD
CONDUCTOR
SWITCH
+
−
CONTROL DEVICE
SOURCE

SCHEMATIC DIAGRAM

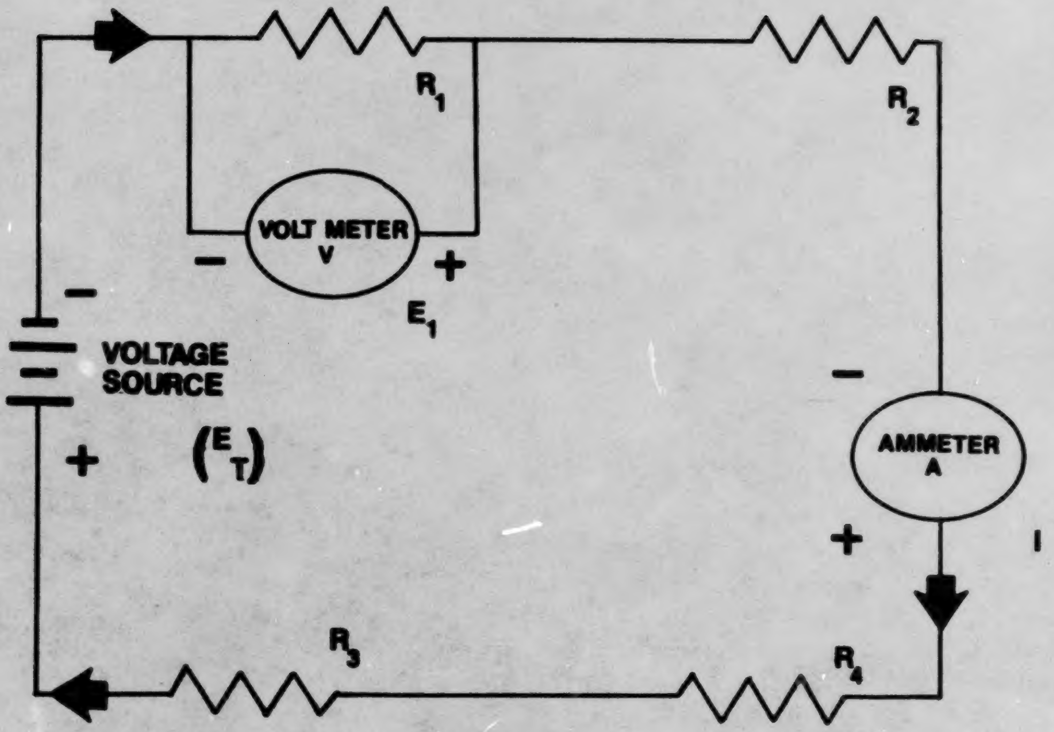
T.M.-6 / EE 3.10-F

BASIC ELECTRICAL CIRCUIT


AMMETER
−
+
(CAMPS)
RESISTANCE = LOAD
(OHMS)
−
VOLTAGE
SOURCE
+
VOLT
METER
(VOLTS)
VOLTMETER
(VOLTS)

E	VOLTAGE (EMF)	VOLTS
I	CURRENT	AMPS
R	RESISTANCE	OHMS

SERIES CIRCUIT


R1
R2
VOLT METER
V
−
+
E1
−
VOLTAGE
SOURCE
+
(ET)
−
AMMETER
A
+
I
R3
R4

$E_{TOTAL} = E_{R_1} + E_{R_2} + E_{R_3} + E_{R_4}$

$I_{TOTAL} = I_{R_1} = I_{R_2} = I_{R_3} = I_{R_4}$

$R_{TOTAL} = R_1 + R_2 + R_3 + R_4$

SERIES CIRCUITS

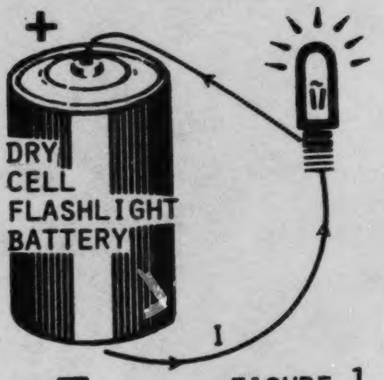

+
DRY
CELL
FLASHLIGHT
BATTERY
I
−

FIGURE 1

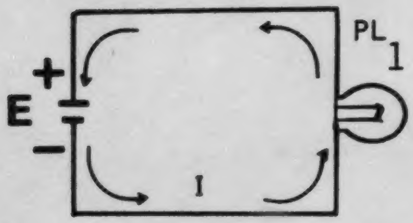


FIGURE 2

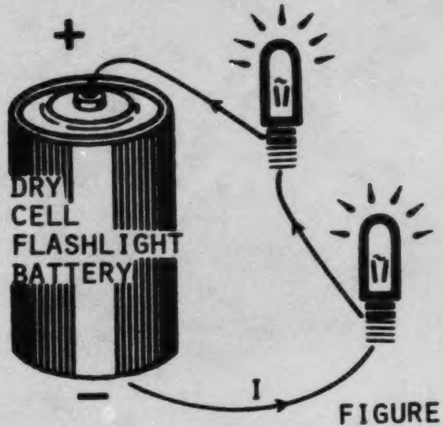

+
DRY
CELL
FLASHLIGHT
BATTERY
I
−

FIGURE 3

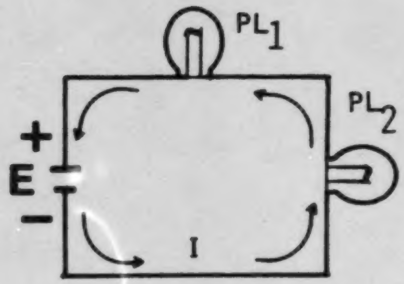


FIGURE 4

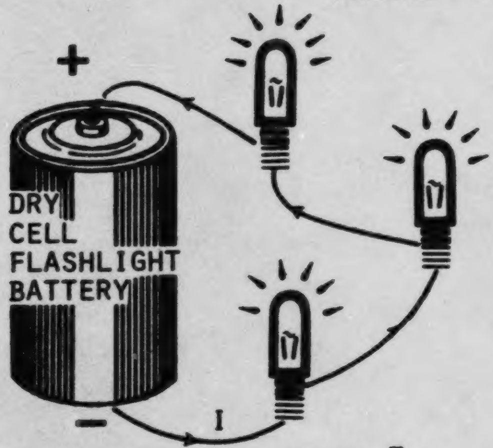

+
DRY
CELL
FLASHLIGHT
BATTERY
I
−

FIGURE 5

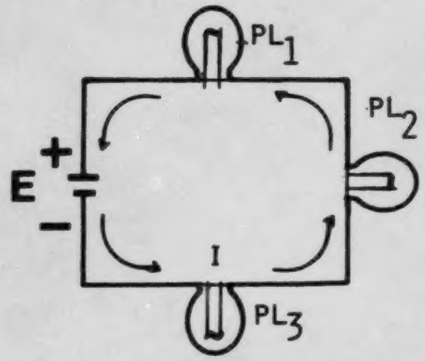
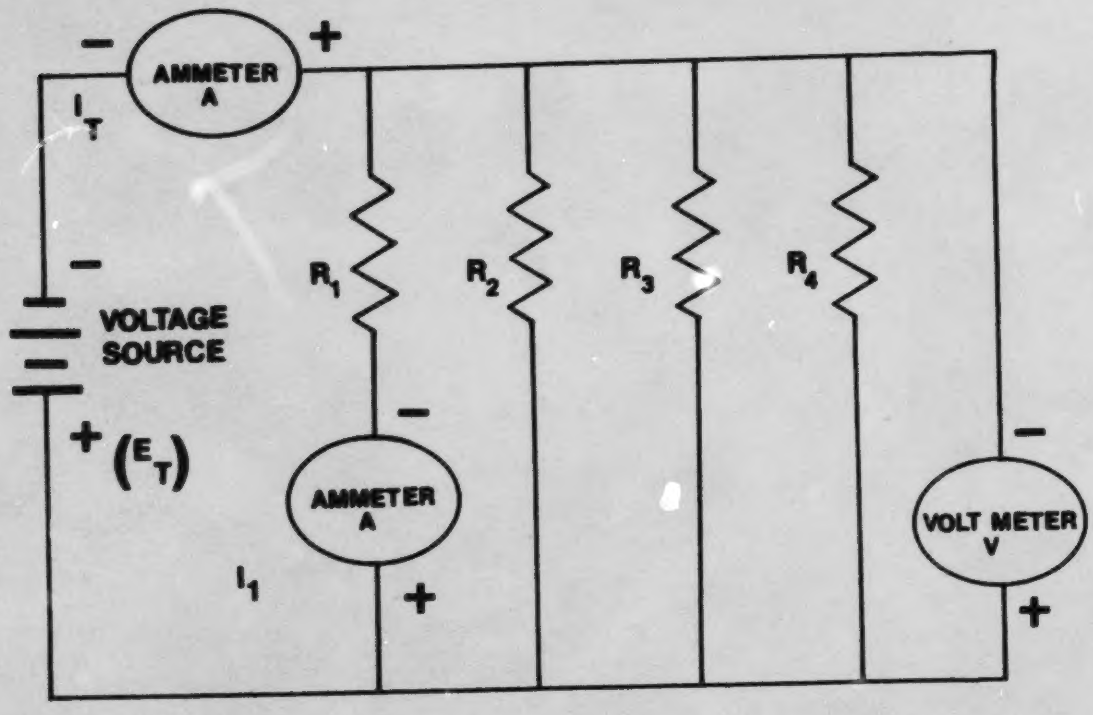

PL_1
PL_2
+
E
−
I
PL_3

FIGURE 6

PARALLEL CIRCUIT


AMMETER
A
−
+
I_T
−
VOLTAGE SOURCE
+
(E_T)
R_1
R_2
R_3
R_4
−
AMMETER
A
+
I_1
−
VOLT METER
V
+

$$E_{TOTAL} = E_{R_1} = E_{R_2} = E_{R_3} = E_{R_3}$$

$$I_{TOTAL} = I_{R_1} + I_{R_2} + I_{R_3} + I_{R_4}$$

$$R_{TOTAL} = \frac{\quad}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}}$$

PARALLEL CIRCUITS

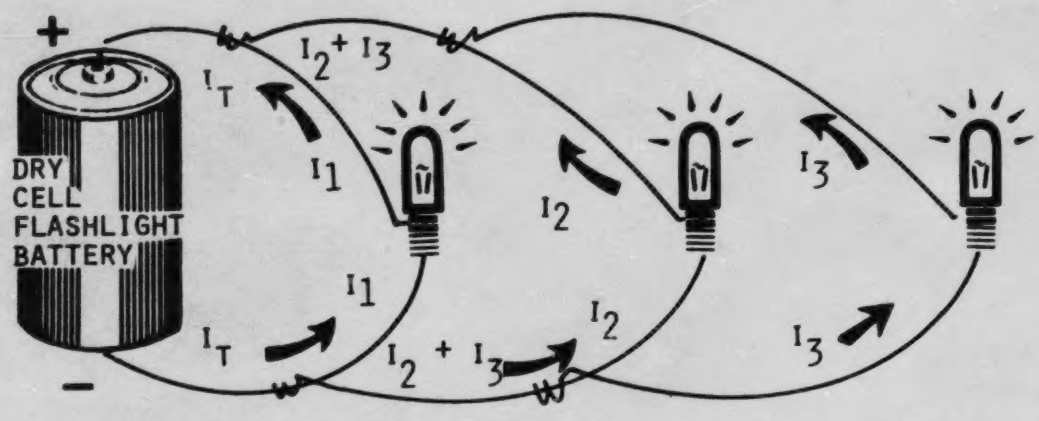

+
−
DRY CELL FLASHLIGHT BATTERY
I_T
$I_2 + I_3$
I_1
I_2
I_3
I_1
I_T
$I_2 + I_3$
I_2
I_3

FIGURE 1

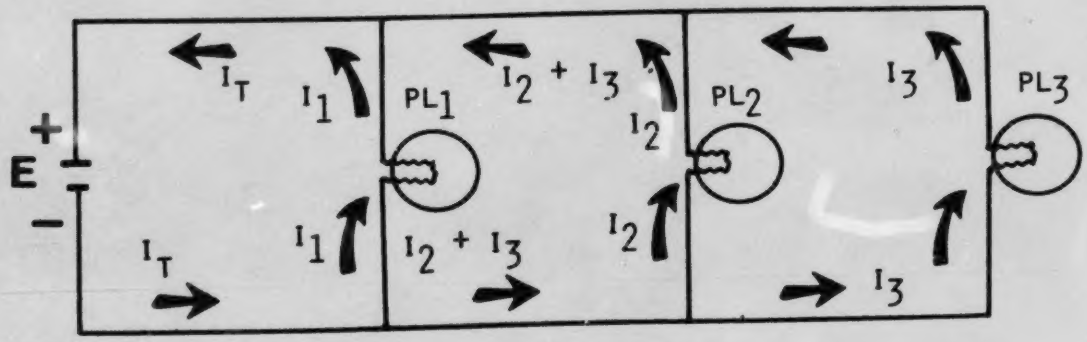
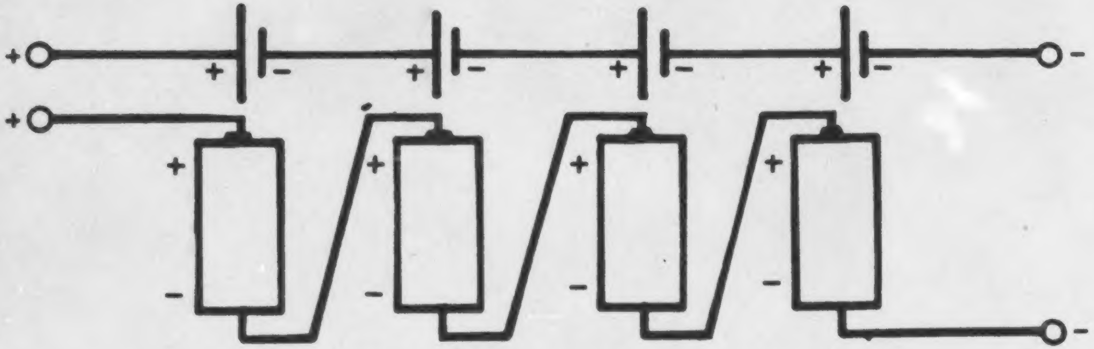
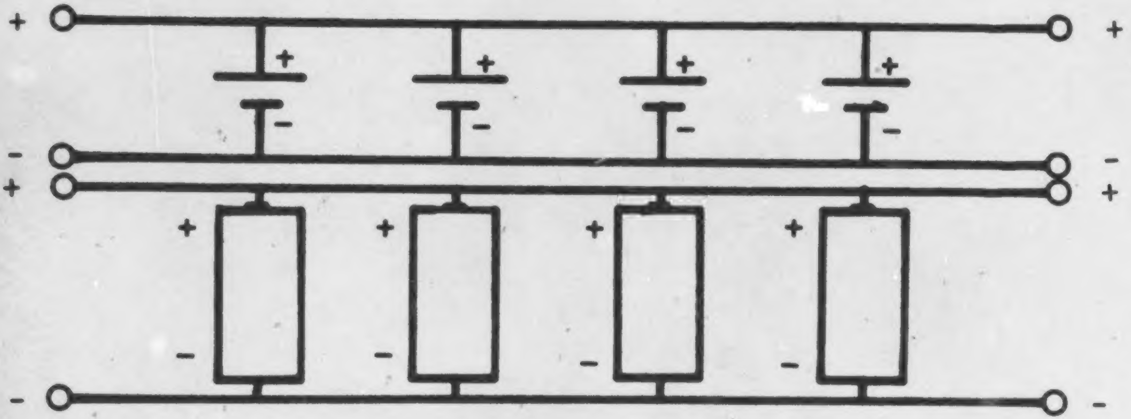

E
+
−
I_T
I_1
PL_1
$I_2 + I_3$
I_2
PL_2
I_3
PL_3
I_1
I_T
$I_2 + I_3$
I_2
I_3

FIGURE 2

CELLS IN SERIES & PARALLEL

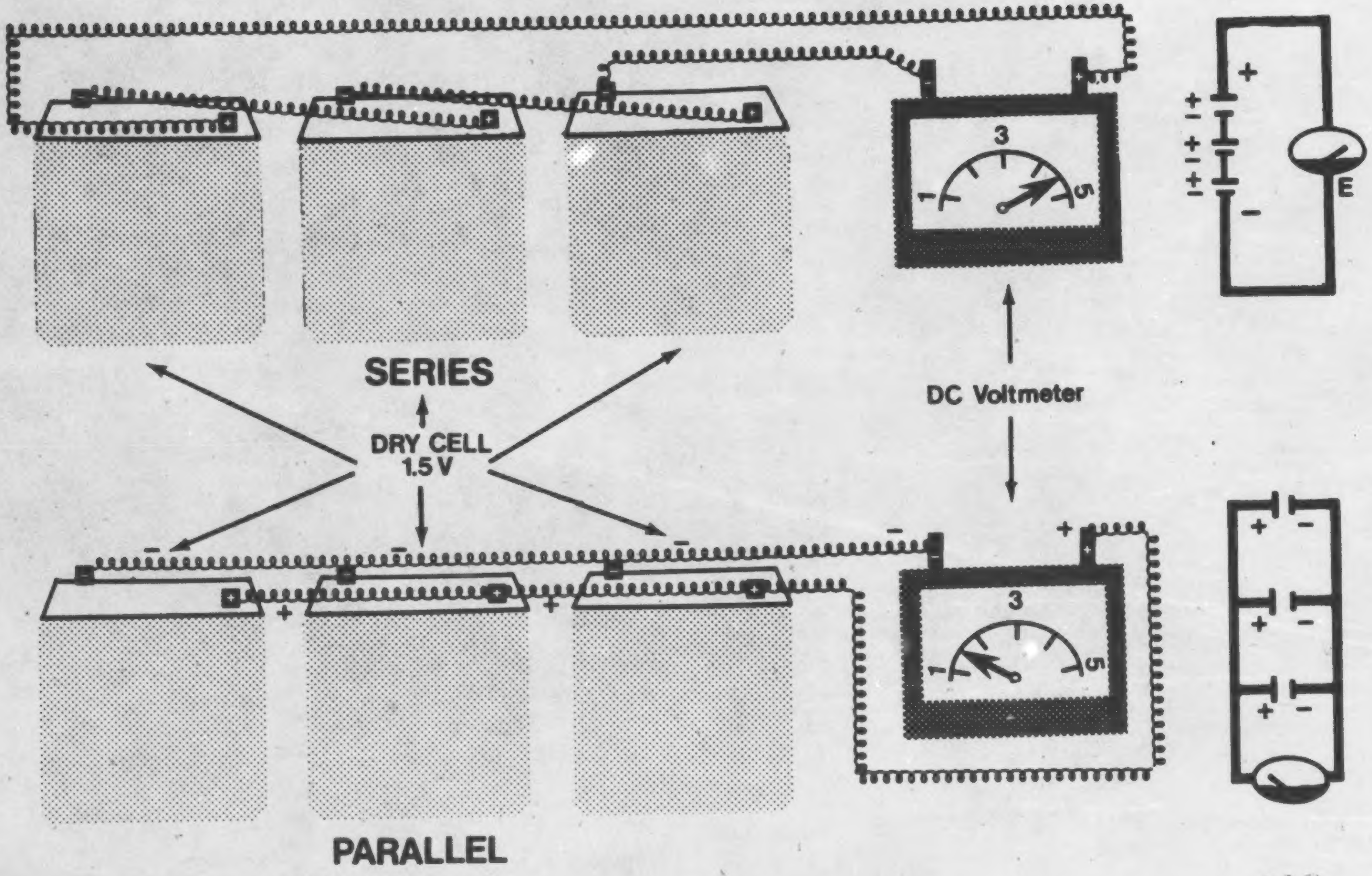


CELLS IN SERIES



CELLS IN PARALLEL

DRY CELL COMBINATIONS


SERIES
DRY CELL
1.5 V
DC Voltmeter
PARALLEL
3
1
5
+
−
E

Demonstration #1

ELECTRONIC COMPONENTS

Objective:

To allow students to actually see various electronic components.

Materials:

1. Resistors of various types and sizes
2. Capacitors of various types and sites
3. Inductors of various types and sizes
4. Transistors of various kinds
5. Integrated circuits of various sizes

Procedure:

1. As the different components are discussed in the outline, pass out the actual components to the students.

Assignment Sheet #1

Color Coding Resistors

Objective:

Using the color code chart:

A. Determine the value of the following resistors:

1. Red Blue Green Silver
2. Brown Black Black
3. Black White Grey Gold
4. Orange Violet Yellow Silver
5. Brown White Blue

B. Determine the color code for the following values:

1. 56 ± 20%
2. 250 ± 10%
3. 35,700 ± 5%
4. 900,000 ± 10%
5. 3 ± 5%

Procedure:

1. Use the color code chart and look up the value of each color.

SUGGESTED TEST

Matching:

_____ 1. Common name for a negative electrode.

_____ 2. Unit of measurement for inductance.

_____ 3. Unit of measurement for resistance.

_____ 4. Coil of wire.

_____ 5. Anything that opposes current flow.

A. Henry

B. Cathode

C. Ohm

D. Resistance

E. Inductor

True or False:

T F 6. All resistors have a power rating.

T F 7. The most common type of resistor is the carbon composition.

T F 8. The insulating material in a capacitor is called the dielectric.

T F 9. Ohm's law states that the voltage in a circuit is equal to the current divided by the resistance.

T F 10. Batteries in series add voltages.

T F 11. A diode tube has two electrodes.

T F 12. Some resistors are color coded to determine power rating.

T F 13. P = I x E refers to Watt's Law.

T F 14. The emitter is part of a transistor.

T F 15. The IC integrated circuit was developed by Bell Labs.

ANSWERS TO TEST

1. B
2. A
3. C
4. E
5. D
6. T
7. T
8. T
9. F
10. T
11. T
12. F
13. T
14. T
15. F

EQUIPMENT/SUPPLIES

Equipment:

1. 24 VOM meters

Supplies:

1. Several resistors of various types and sizes
2. Several capacitors of various types and sizes
3. Several inductors of various types and sizes
4. Several transistors of various types and sizes
5. Several integrated circuits of various types and sizes

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

RADIO

DESCRIPTION OF UNIT

This unit will cover the basic concepts of radio. It will give an overview of the following areas: What is radio?, radio wave propogation, message channels, radio wave reception and uses of radio. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify terms and definitions, describe how radio waves are transmitted, describe message channels used for radio, describe how radio waves are received and list and describe uses of radio.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given terms to the correct definition or description.
2. Describe how radio waves are transmitted.
3. Describe two types of message channels.
4. Describe how radio waves are received.
5. List and describe 8 uses of radio.

OUTLINE OF CONTENT

I. What is Radio

A. Definition--Communication by electromagnetic waves transmitted through space.

B. Electromagnetic waves--The radiant energy produced by oscillation of an electric charge. Included are audio and radio waves; infrared, visible and ultraviolet light waves; and X-, gamma, and cosmic rays.

C. Audio frequencies--Those frequencies of the electromagnetic spectrum that can be heard by the human ear.

D. Radio frequencies (RF)--Those frequencies above audio frequencies and below light in the electromagnetic spectrum at which coherent electromagnetic radiation of energy is possible.

E. Intelligence--Intelligence for the sake of electronics communications is that information which is being communicated.

F. Carrier wave--This is an RF frequency generated in a transmitter and used as a vehicle to "carry" the intelligence. The intelligence is impressed (modulated) onto the carrier wave in the transmitter before transmission occurs.

G. Modulation--This is the process by which the intelligence is impressed onto the carrier wave. There are two types of modulation: amplitude modulation and frequency modulation.

1. Amplitude modulation (AM)--This is modulation where the amplitude of the carrier wave is caused to vary.

2. Frequency modulation (FM)--This is modulation where the frequency of the carrier wave is caused to vary.

H. Antenna--A device used to radiate electromagnetic waves into the atmosphere.

I. Microphone--A device used to convert sound waves into an electrical signal in the audio frequency range.

II. Radio Wave Propogation

A. Information source--In radio the information source is usually a person speaking into a microphone. In the entertainment radio field the information source could also be a tape playback unit or a record player.

B. Encoder or transmitter--Encoding and transmission both take place in one unit in radio, the transmitter. It is here that the carrier wave is generated. The audio signal from the information source is amplified and modulated on to the carrier wave. The resulting signal is amplified and then transmitted either via an antenna or through a cable.

III. Message Channel

A. Open circuit--An open circuit transmission channel is where the transmitted signal is radiated via an antenna into the atmosphere.

B. Closed circuit--A closed circuit transmission channel is where the transmitted signal is sent through a cable and is not radiated into the atmosphere.

IV. Radio Frequency Reception

A. Decoder or receiver--Radio waves are picked up by an antenna and sent via cable to the tuning section of the receiver. The tuning section determines which frequencies will pass through to the demodulation section of the receiver where the audio (intelligence) portion of the signal is separated from the carrier wave, amplified and sent on to the information destination

B. Information destination--The information destination in radio is usually a speaker of some sort where the audio signal is converted into sound waves.

V. Uses of Radio

A. Commercial radio--Commercial radio brings us music, news, sports, weather, special events and last but definitely not least, the commercial message. It is this commercial message that makes commercial radio commercial. Sponsors pay for the air time to broadcast the music, news, etc. and in turn they get to advertise their products. This is how commercial radio gets its operating funds. Commercial radio has both AM and FM stations. Although about the same programming exists on both AM and FM there are some advantages and disadvantages to both.

1. AM

   a. Advantage--Longer range, over the horizon transmission.

   b. Disadvantage--More static noise.

2. FM

   a. Advantage--Almost no noise and easier to multiplex for stereo.

   b. Disadvantage--Line of sight transmission only.

B. Public radio--Like commercial radio in all the technical aspects it is in funding and programming that the difference between public and commercial radio is found. Funding for public radio comes entirely from private donations and grants and as a result there are no commercials on public radio. In the area of programming, public radio lends itself more to educational and cultural programming. Although public radio uses both AM and FM, due to the nature of their programs most stations are FM for stereo and low noise properties.

C. Amateur radio--An amateur radio operator is called a "Ham" and amateur radio is often called "Ham Radio". Using mostly AM radio equipment, Ham's can talk around the block or around the world. Although most ham radio communication is just for the sake of the hobby, ham operators are sometimes banded together in networks for communications during emergency situations. The seriousness for their radio hobby is evidenced by the tests that ham's have to pass and the licenses they have to acquire before they are allowed on the air.

D. Citizens band radio--Called CB, citizens band radio is one of the fastest growing businesses in the U.S. People have CB's in their home and cars, on boats and motorcycles, and some aircraft are equipped with CB. The FCC requires a license to operate a CB but it is just a formality and requires only that the person fill out a form and mail it to the FCC. There are three primary uses of CB: personal, business, and emergency.

   1. Personal--Chatting with friends, looking for police radar, checking on weather and road conditions, passing the time or staying awake on a long trip, getting local directions and finding a good place to eat are just some of the personal uses of CB radio.

   2. Business--Many businesses have CB base stations in their offices and mobile rigs in their company vehicles. This provides for instant communication between the office and the employee in the field.

   3. Emergency--Channel 9 is the CB emergency channel. In most areas there are organized groups that monitor channel 9 and if an emergency occurs, a distress call on channel 9 will usually bring help quickly.

E. Police and fire--Police and fire departments use radio to dispatch personnel and vehicles to problem areas and to coordinate operations in the field.

F. Military--The military uses radio for such things as troop and supply deployment, coordination of forces in the field, and calling in artillery fire and air strikes from field positions.

G. Aviation--Most all aircraft have aviation radios on board so they can maintain contact with air traffic controllers. They also have radio equipment on board that provides course and position information.

H. Recreational--Several million people enjoy operating scale model radio controlled (RC) cars, boats and planes as a hobby. Although some people who are very serious about this hobby build their own vehicles and radio equipment; preassembled, ready to operate RC equipment can be bought and most RC equipment may be operated with an FCC class C license.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheet and go through outline of material giving demonstrations as you go.

V. Discuss student activity sheets.

VI. Give test.

VII. Plan field trip to radio station. (Suggested)

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Take field trip. (Suggested)

REFERENCES/RESOURCES

References:

1. Miller, Rex, Communication: Electricity and Electronics, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

2. Gerrish, Howard H.; Dugger, William E., Electricity and Electronics, South Holland, Ill.: Goodheart-Wilcox Co., Inc. 1977.

3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, New York: McGraw-Hill, Inc. 1972.

4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hill, Inc. 1969, 2nd Ed.

5. Collier, James Lincoln, CB, New York, NY, Franklin Watts, 1977.

6. Wels, Byron G., Here is Your Hobby: Amateur Radio, New York, NY, G.P. Putnam's Sons, 1968.

7. Meyer, Jerome S., Picture Book of Radio and Television, New York, NY, Lothrop, Lee & Shepard Co., Inc., 1951.

Resources:

1. Information Sheets
2. Transparency Masters
3. Demonstrations
4. Activity Sheets

Information Sheet #1

Terms and Definitions:

1. AM--Amplitude modulation; this is modulation where the amplitude of the carrier wave is modulated.
2. Antenna--A device, usually wires or rods, used for radiating electromagnetic waves into or receiving them from space.
3. Audio frequency (af)--Those frequencies in the electromagnetic wave spectrum that can be heard by the human ear.
4. Broadcast--Radio or television transmission intended for public reception without payment to the station.
5. Carrier wave--A single-frequency rf wave which is used as a "vehicle" for and modulated by another wave containing the intelligence.
6. Electromagnetic wave--The radiant energy produced by the oscillation of an electric charge. It contains audio and radio waves, infrared, visible, and ultraviolet light waves and X-, gamma and cosmic rays.
7. FM--Frequency modulation; this is modulation where the frequency of the carrier wave is modulated.
8. Intelligence--That part of an electronic communications signal that is the information being transmitted.
9. Microphone--An electronic device used for converting sound waves into an electrical signal.
10. Modulation--The process by which the intelligence is impressed onto the carrier wave.
11. Radio--Communication by electromagnetic waves transmitted through space.
12. Radio frequency--Those frequencies at which coherent electromagnetic radiation of energy is possible.
13. Receiver--Electronic device used to convert a received signal into a visible or audible form.
14. Speaker--An electroacoustic device used to convert an audio frequency signal into sound waves.
15. Static--Noise created in a signal by natural weather phenomena and electrical charges existing in the atmosphere.

16. Transceiver--Electronics device that will both transmit and receive signals.

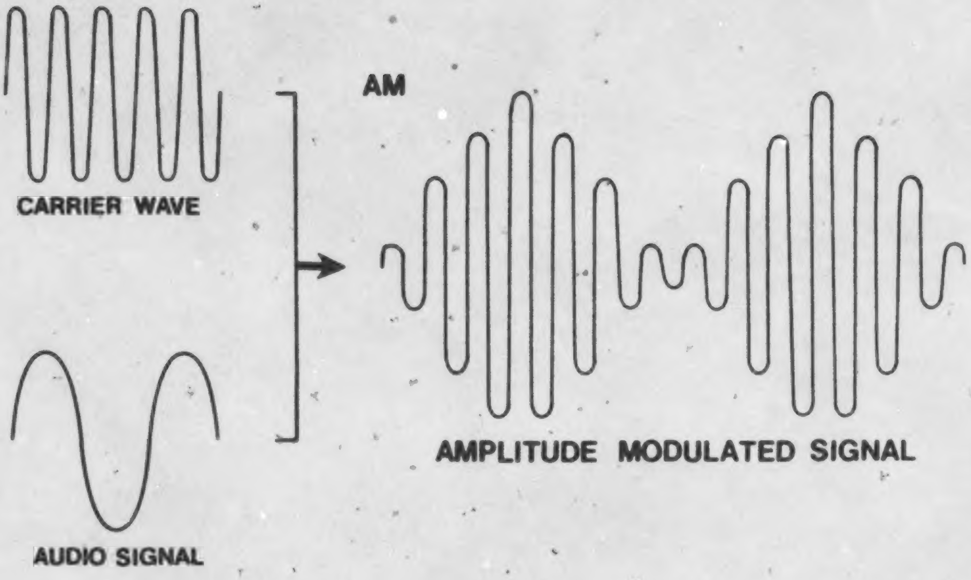
17. Transmitter--Electronics device used to generate an rf carrier wave, modulate this carrier with intelligence, amplify and radiate the modulated carrier into space.

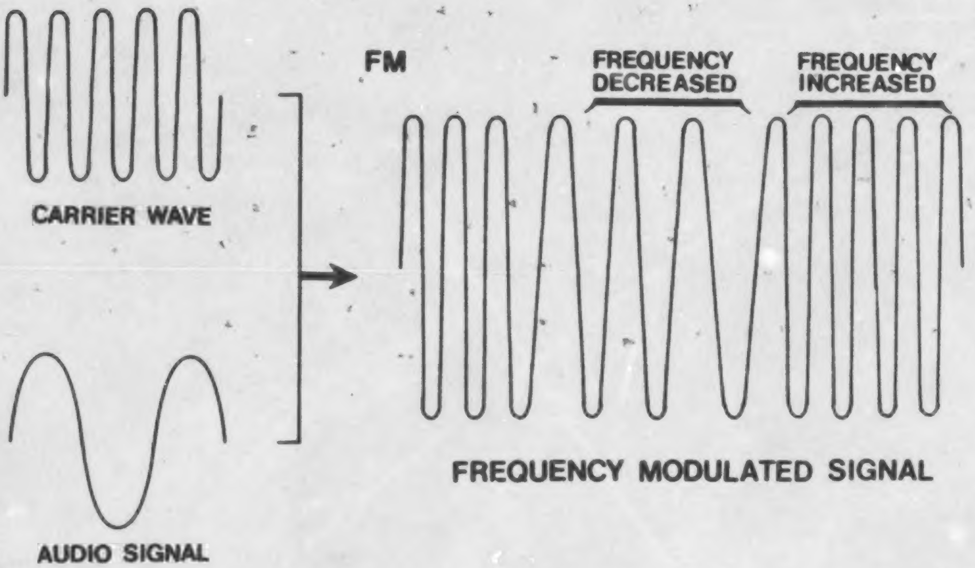
Information Sheet #2

COMMUNICATIONS FREQUENCY SPECTRUM

Band	Abbreviations	Frequency
Audio Frequency	—	20-30,000 Hz
Very Low Frequency	VLF	Below 30 KHz
Low Frequency	LF	30-300 KHz
Medium Frequency	MF	300-3000 KHz
High Frequency	HF	3000-30,000 KHz
Very High Frequency	VHF	30,000 KHz-300 M
Ultra High Frequency	UHF	300-3000 MHz

MODULATION


CARRIER WAVE
AUDIO SIGNAL
AM
AMPLITUDE MODULATED SIGNAL


CARRIER WAVE
AUDIO SIGNAL
FM
FREQUENCY DECREASED
FREQUENCY INCREASED
FREQUENCY MODULATED SIGNAL

Demonstration #1

RADIO TRANSMISSION AND RECEPTION

Objective:

To show how radio is used as a communications medium.

Materials:

1. 1 Radio Shack AM transmitter kit #28-209
2. 1 Radio Shack Solar-Powered AM radio kit #28-214

Procedure:

1. Construct the kits as per the instructions provided.
2. Demonstrate sending and receiving messages.

Demonstration #2

USING RADIO EQUIPMENT

Objective:

To show the use of as many types of radio equipment as possible.

Materials:

1. As many different types (Ham, CB, short wave, etc.) of radio equipment as you can get your students or parents of students to bring in.

Procedure:

1. Describe the piece of equipment and its function.
2. Operate (either you or the student) the piece of equipment.
3. If allowable, let the other students operate the piece of equipment.

Student Activity #1

CONSTRUCTING A CRYSTAL RADIO

Objective:

To construct a simple crystal AM radio.

Materials:

1. 1 Radio Shack crystal AM radio kit #28-207

Procedure:

1. Read the theory of operation provided.
2. Construct the kit as per the instructions.
3. Determine how many stations can be picked up on your radio.

SUGGESTED TEST

Matching:

A. Static

B. Microphone

C. Broadcast

D. AM

E. Speaker

____ 1. Modulation of the amplitude of a signal.

____ 2. Noise due to atmospheric conditions.

____ 3. Device for converting electrical waves into sound waves.

____ 4. Device used to convert sound waves into electrical waves.

____ 5. Radio or television transmission intended for public reception without payment to the station.

True or False:

T F 6. Audio frequencies can be heard by the human ear.

T F 7. There are three types of modulation in radio.

T F 8. Radio frequencies are above light waves in the electromagnetic spectrum.

T F 9. Modulation is the process by which the intelligence is impressed onto the carrier wave.

T F 10. AM radio has less noise than FM.

T F 11. Public radio operators are called "Hams".

T F 12. Operating a CB radio does not require a license.

T F 13. Channel 9 is the CB emergency channel.

T F 14. Commercial radio is funded primarily by grants and private donations.

T F 15. Airplanes use radios to maintain contact with air taffic controllers.

ANSWERS TO TEST

1. D
2. A
3. E
4. B
5. C
6. T
7. F
8. F
9. T
10. F
11. F
12. F
13. T
14. F
15. T

EQUIPMENT/SUPPLIES

Equipment:

1. 24 VOM meters

Supplies:

1. 1 Radio Shack AM transmitter kit #28-209)
2. 1 Radio Shack Solar-Powered AM radio kit #28-214
3. 24 Radio Shack crystal AM radio kits #28-207

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

TELEGRAPH

DESCRIPTION OF UNIT

This unit will cover the basic concepts of the telegraph. It will give an overview of the following areas: How the telegraph works, Western Union today, and the uses of the telegraph as a communication system. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify terms and definitions, describe how the early telegraph worked, describe how today's teletypewriter works and list and describe uses of today's telegraph system as a communications system.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given terms to the correct definitions and descriptions.
2. Describe how the early telegraph worked.
3. Describe how today's teletypewriter system worked.
4. List and describe 5 uses of today's telegraph system as a communications system.

OUTLINE OF CONTENT

I. How it Works

A. Early system--The telegraph was the first fast means of long distance communication. The actual telegraph was a very simple device consisting of a key, sounder and a power source.

1. Key--This was simply a spring loaded normally open switch. When the key was depressed, current flowed through the system.

2. Sounder--This consisted of an electromagnet with a metal bar positioned above it. When current flowed through the electromagnet the bar was pulled down causing an audible click. When current flow ceased the bar was released also causing an audible click.

3. Power source--The primary power source was a chemical cell battery.

4. Morse Code--Named after the American inventor of the telegraph this is a code where each letter of the alphabet is coded with dots and dashes. A dot was represented by about 1/4 of a second between clicks on the sounder and the dash was about three times that.

B. Today's System--The simple telegraph of the early days has been replaced by a much more sophisticated piece of equipment, the teletypewriter. All telegrams, and most all other services offered by Western Union (the primary telegraph company in the U.S.), are sent via the teletypewriter. Teletypewriters are capable of sending and receiving between 65 and 100 words per minute.

1. Information source--There are two sources of information for a teletypewriter. One is the keyboard which resembles a standard typewriter and the other is a paper tape coded with punched holes.

2. Encoder or transmitter--In the base of a teletypewriter is a device that constructs and transmits an electronically coded signal. The coded signal is made up of electronic pulses. This device is activated by either the keyboard or a punched tape. The device does not use a carrier wave.

3. Message channels--The primary message channels used by Western Union are coaxial cable and microwave transmission. Most all of both of these channels are leased from the Bell System.

4. Decoder or receiver--Also located in the base of the teletypewriter is a device which receives and decodes the coded signal.

5. Information destination--As the coded signal is decoded, the keyboard, which is the final destination of the signal, is activated and typed copy results.

II. Western Union and its Services

A. The Company--Western Union today, is for all practical purposes the only telegraph company operating in the U.S. Although Western Union grew up around the telegraph and telegram, most of its business today is derived from leasing teletypewriters for data communications.

B. The Services--Along with the leasing of teletypewriters, Western Union still offers a wide range of personal messages, many of which can be billed to your home telephone.

1. Telegram--This is a message sent by teletypewriter and delivered by telephone or messenger if requested.

2. Mailgram--This is a message sent by teletypewriter to a local post office and then delivered as a letter.

3. Moneygram--This is a service for sending money from one person to another via a message sent by teletypewriter. An equal amount of money paid at one Western Union office is paid to the moneygram recipient at another Western Union office.

4. Specialty services--Candygram, singing telegram, and flowers sent by wire are some of the other services offered by Western Union.

5. Teletypewriter leasing--Many companies lease teletypewriter equipment and cable services from Western Union for data communications purposes. It is this that makes up the majority of Western Union's business today.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheet and go through outline of material giving demonstrations as you go.

V. Bring in a guest speaker from Western Union. (suggested)

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Complete activity sheet.

REFERENCES/RESOURCES

References:

1. Miller, Rex, Communication: Electricity and Electronics, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

2. Gerrish, Howard H.; Dugger, William E., Electricity and Electronics, South Holland, Ill.: Goodheart-Wilcox Co., Inc. 1977.

3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, New York: McGraw-Hill, Inc. 1972.

4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hall, Inc. 1969, 2nd Ed.

Resources:

1. Information Sheets
2. Transparency Masters
3. Demonstrations
4. Activity Sheets

Terms and Definitions:

1. Key--Hand operated switch used to open and close a circuit.
2. Morse code--A code system of dot-and-dash signals developed by Samuel F.B. Morse.
3. Sounder--A telegraph receiving instrument consisting of an electromagnet and a moving armature.
4. Telegraph--A system that employs interruptions or polarity changes of direct current for the transmission of coded signals.
5. Teletypewriter--A telegraph instrument with a signal activated device for automatically typing received messages and a keyboard for sending messages.

Information Sheet #2

INTERNATIONAL MORSE CODE

Alphabet

A	• —
B	— • • •
C	— • — •
D	— • •
E	•
F	• • — •
G	— — •
H	• • • •
I	• •
J	• — — —
K	— • —
L	• — • •
M	— —
N	— •
O	— — —
P	• — — •
Q	— — • —
R	• — •
S	• • •
T	—
U	• • —
V	• • • —
W	• — —
X	— • • —
Y	— • — —
Z	— — • •
Period	• — • — • —
Comma	— — • • — —
Question mark	• • — — • •

Numbers

1	• — — — —
2	• • — — —
3	• • • — —
4	• • • • —
5	• • • • •
6	— • • • •
7	— — • • •
8	— — — • •
9	— — — — •
0	— — — — —

Demonstration #1

Sending and Receiving Morse Code

Objective:

Using a simple buzzer circuit, demonstrate how a simple telegraph system would work using Morse Code.

Materials:

1. 1 buzzer (doorbell type)
2. 1 transformer (for buzzer)
3. 1 telegraph code key

Procedure:

1. Construct a simple series circuit with the switch buzzer and source.
2. Prepare a short simple coded message using Morse Code.
3. Tap out the message to the class using the buzzer circuit. (Make sure to leave a time gap between letters.)

Assignment Sheet #1

Using Morse Code

Objective:

To code a message into Morse code and to listen to a coded message tapped out on a buzzer circuit and decode it.

Materials:

1. Morse Code handout
2. Paper
3. Pencil

Procedure:

1. Using the Morse Code handout sheet, put the following into Morse code.

   I would like to make an A in this course. Would you?

2. Copy down (in dots and dashes) a message tapped out on a buzzer by the teacher and use the Morse code handout to decode the message.

SUGGESTED TEST

True or False:

T F 1. Morse code was invented by Samuel Morse.

T F 2. The telegraph ws the first fast means of long distance communication.

T F 3. The primary power source for the early telegraph was a simple electric generator.

T F 4. The sounder is part of today's telegraph system.

T F 5. The telegram is the primary business of Western Union today.

T F 6. Western Union, for all practical purposes, is the only telegraph company operating in the U.S. today.

T F 7. The teletypewriter is the main piece of equipment used by Western Union today.

T F 8. The mailgram is a message delivered by personal messenger.

T F 9. The early telegraph consisted of 3 primary components.

T F 10. Modern teletypewriters are capable of sending between 65 and 100 words per minute.

ANSWERS TO TEST

1. T
2. T
3. F
4. F
5. F
6. T
7. T
8. F
9. T
10. T

EQUIPMENT/SUPPLIES

Equipment:

1. 1 buzzer (doorbell type)
2. 1 transformer (for buzzer)
3. 1 telegraph code key

Supplies:

1. 1 piece of wood 6" x 12" x 1"

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

TELEPHONE

DESCRIPTION OF UNIT

This unit will cover the basic concepts of the telephone. It will give an overview of the following areas: how the telephone works, the Bell system, uses of the telephone, and uses of the Bell system telecommunications network. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify terms and definitions, describe how the telephone works, describe the Bell system, list and describe uses of the telephone, list and describe uses of the Bell system telecommunications network.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given terms to definitions and descriptions.

2. Describe how the telephone works.

3. Describe the Bell system.

4. List and describe 2 uses of the telephone.

5. List and describe 4 uses of the Bell system telecommunications network.

OUTLINE OF CONTENT

I. How it Works

A. Central Office--The nerve center of the telephone network. This is where all of switching equipment and radio transmission equipment is located. All calls are routed through a central office. There may be 1 or many central offices in a city. It depends on the number of phones.

B. Information Source--In the modern telephone the information source is a carbon microphone inside the mouthpiece of the handheld unit. this microphone changes the sound waves produced by the voice into an electrical audio signal. This signal goes over wire to a central office.

C. Encoder or Transmitter--When the electrical signal reaches the central office one of two things happens. If the call is a local call to a phone number originating in the same central office then the simple audio signal is amplified and sent to the receiving phone. If it is a local call that has to go through another central office or if it is a long distance call the audio is modulated onto an RF carrier wave in a radio transmitter and transmitted.

D. Message Channel--There are 1) three primary channels now used in the transmission of signals in the Bell System and 2) some experimental channels.

1. Primary Channels

a. Open wire--This consists of a pair (or several pairs together in a cable) of insulated copper conductors. It takes one pair for a complete circuit and this is good for voice only.

b. Coaxial cable--This is a special type of cable that is shielded against outside interference from radio waves. Using coaxial cable allows many calls to be "multiplexed" onto carrier waves and transmitted all on one cable at the same time. Coaxial can carry radio or TV signals as well as voice.

c. Microwave--Using high frequency radio waves (microwaves), phone calls can be modulated and multiplexed onto these high carrier frequencies and transmitted along a series of relay towers from city to city. Microwaves can also be bounced off of satellites to span the globe. Microwave can also carry radio or TV signals as well as voice.

2. Experimental Channels

   a. Laser--This is a special highly concentrated beam of coherent light. It may be able to be used in place of radio waves as a communications medium.

   b. Fiber optics--These are a special type of long thin flexible glass fibers which are being developed to use as a conduit for lazer communications.

E. Decoder or Receiver--When a phone call that has been modulated onto a carrier wave reaches the last central office on its path to its destination phone, the audio signal is retrieved from the carrier wave and then sent toward its final destination.

F. Information Destination--The earpiece of a telephone is the final destination and is actually a small speaker that changes the audio signal into sound waves that can be heard by the human ear.

G. Dial Circuit--There are two types of dial circuits in today's phones. These are the rotary and the touchtone.

   1. Rotary--This is the method whereby a person rotates a numbered dial on the phone. Each number, when dialed, causes a corresponding number of clicks. These clicks are counted by special equipment at the central office and switches are opened and closed to route the call on its proper path.

   2. Touchtone--Instead of dialing numbers with this system a person just touches the numbers in sequence. Each number, when pushed, emits a certain tone (frequency of sound) and equipment at the central office "hears" the different tones and this begins the switching procedure to route the call properly.

II. The Bell System

   A. The Business--The Bell System is made up of 26 different corporations, each of which perform a separate task and all of which, working closely together, form the largest telecommunications system in the world.

   B. Telecommunications Network--The Bell System network is the heart of the communications industry in the United States. Most private homes have a phone and almost without exception, businesses and industries use this vast network in one or more ways. It is composed of hundreds of thousands of miles of wire, cable, microwave relay networks, and satellites. These all work together for the largest, fastest, and most used communications network in the world.

C. Bell Labs--One of the 26 corporations, this is the research arm of the Bell System. Scientists here are responsible for developing and designing new devices and techniques for improved communications services. One of the most notable accomplishments of Bell Labs was the invention of the transister there in 1948.

III. Uses of the Telephone

A. Personal--The personal telephone is used for everything from idle chit chat to summoning the police or fire department in an emergency (includes local and long distance). (Discuss personal uses with students.)

B. Business--The business phone provides quick and economical communication between the business and the consumer, between businesses, and between people within a business.

IV. Uses of the Bell System Telecommunications Network

A. Private--All private phone calls go through the network.

B. Business and Industrial--Along with their phones, many businesses lease cable or satellite time from the Bell System. Some examples are:

1. Western Union leases most of its cable from the Bell System.

2. Radio and TV networks use the Bell System to route network programming from their main studios to their affiliate stations all across the country.

3. Many data communications companies lease cable or satellite time from the Bell System.

C. Government--The government leases cable from the Bell System for a lot of its communication needs. Three examples are:

1. Military--Much of the high level and top secret military communications systems use cable leased from the Bell System.

2. Air traffic control centers across the country are tied together through the Bell network and their phone bill is over $1,000,000 per month.

3. Direct lines--Many government agencies have direct phone lines to other agencies for special use. An example would be the red phone in the White House that connects Washington and Moscow, USSR.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheet and go through outline of material, giving demonstrations as you go.

IV. Contact the local Bell telephone representative for film, field trip, and demonstration information. (Suggested)

V. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Take field trip. (Suggested)

IV. Take test.

REFERENCES/RESOURCES

References:

1. Miller, Rex, Communication: Electricity and Electronics, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

2. Gerrish, Howard H.; Dugger, William E., Electricity and Electronics, South Holland, Ill.: Goodheart-Wilcox Co., Inc. 1977.

3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, New York: McGraw-Hill, Inc. 1972.

4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hall, Inc. 1969, 2nd Ed.

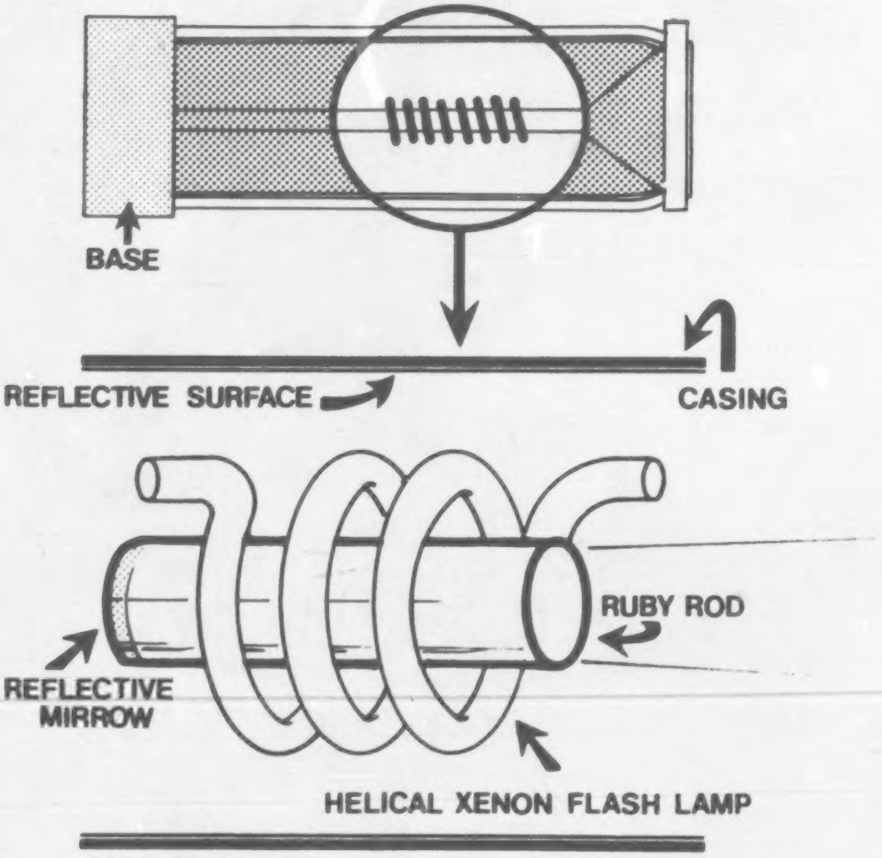
Resources:

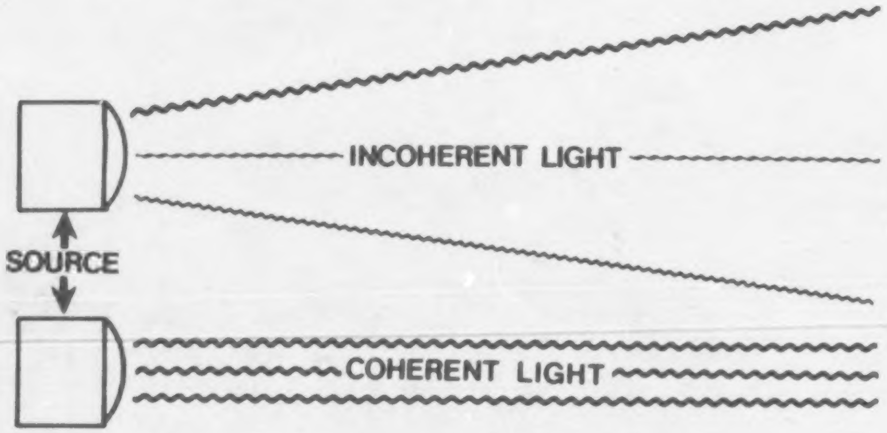
1. Information Sheets
2. Transparency Masters
3. Demonstrations
4. Activity Sheets
5. Bell Telephone (films, demonstrations, field trips)

Terms and Definitions:

1. Coaxial cable--Special type of cable that is shielded against outside interferences.
2. Fiber optics--Transparent glass fibers capable of transmitting light from one end to the other, straight or curved.
3. Laser--A device used to transform incoherent light of various frequencies into a very narrow, intense beam of coherent light.
4. Microwave--Term applied to radio waves in the frequency range of 1000 MHz and upward toward light.
5. Telephone--Combination of apparatus for converting sound waves to electrical waves, transmitting them to a distant point, and there converts these waves back into audible sounds.

LASER


BASE
REFLECTIVE SURFACE
CASING
RUBY ROD
REFLECTIVE MIRROR
HELICAL XENON FLASH LAMP


INCOHERENT LIGHT
SOURCE
COHERENT LIGHT

Demonstration #1

Telephone Cable

Objective:

To show the student different types of phone cable.

Materials:

1. 12" of a single pair
2. 12" of a multipair cable
3. 12" of coaxial cable
4. 12" of coaxial line

(NOTE: Contact your local Bell company for these materials.)

Procedure:

1. Pass the pieces around the room.
2. Explain each type.

Demonstration #2

Telephone

Objective:

To show the students the different parts of the interior of a telephone.

Materials:

1. 1 telephone (dial type) (Borrow from Bell Telephone)
2. 1 telephone (touch-tone type) (Borrow from Bell Telephone)

Procedure:

1. Show both phones and explain the difference between the dial and touch-tone systems.
2. Disassemble the mouthpiece of each phone and show the microphone.
3. Disassemble the earpiece of each phone and show the speaker.
4. Take the cover off of each phone and point out the dial circuitry and the touch-tone circuitry.
5. Point out the bells that ring.
6. Point out and discuss any other items of interest within the phone.

SUGGESTED TEST

True or False:

T F 1. The central office plays only a minor role in the telephone system.

T F 2. The mouthpiece of a telephone contains a microphone.

T F 3. The earpiece of a telephone contains a speaker.

T F 4. The Bell System consists of 20 different corporations.

T F 5. The laser is a concentrated beam of coherent light.

T F 6. Coaxial cable is shielded against outside interference.

T F 7. Touchtone is a type of dial system.

T F 8. The Bell System has the third largest telecommunication network in the U.S.

T F 9. Radio and television networks use the Bell System to route network programming from the network studio to the local station.

T F 10. The transistor was developed at Bell Labs in 1948.

ANSWERS TO TEST

1. F
2. T
3. T
4. F
5. T
6. T
7. T
8. F
9. T
10. T

EQUIPMENT/SUPPLIES

Equipment:

1. 1 telephone (dial type)
2. 1 telephone (touch-tone type)

Supplies:

1. 12" of a single pair of telephone wires
2. 12" of a multipair cable
3. 12" of coaxial cable
4. 12" of coaxial line

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY--ELECTRONICS

Title of Unit:

TELEVISION

DESCRIPTION OF UNIT

This unit will cover the basic concepts of television. It will give an overview of the following areas: What is television?, TV signal propogation, message channels, TV signal detection, and uses of television. The materials in this unit are designed for 6 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify terms and definitions, describe how television signals are propogted, describe television channels used for television, describe how television signals are detected, and list and describe uses of television.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match given terms to the correct definition or description.
2. Describe how television signals are propogated.
3. Describe two types of message channels.
4. Describe how television signals are detected.
5. List and describe 7 uses of television.

OUTLINE OF CONTENT

I. What is Television

   A. Definition--Television (TV) is a telecommunication system used for the transmission of images of fixed or moving objects. These images are usually accompanied by sound.

   B. VHF--This stands for "very high frequency" and includes those frequencies in the RF spectrum between 30 and 300 MHz. There are 12 channels in the VHF band, 2-13. VHF, for broadcast purposes has been in use longer than UHF because VHF equipment is cheaper to operate than UHF equipment due to VHF's lower frequencies.

   C. UHF--This stands for "ultrahigh frequency" and includes those frequencies in the RF spectrum between 300 and 3000 MHz. There are 70 channels in the UHF band. Two things have opened wide the door for UHF TV in this country. One was the invention of a special type of vacuum tube which has greatly reduced the operating cost of UHF equipment. The other was the passage of a federal law in the early 60's that made it mandatory for all TV sets sold in the U.S. to have both VHF and UHF capability. Before this law most TV manufacturers installed only VHF tuners in their sets. One advantage of UHF over VHF is the number of channels available.

   D. Channel--A TV channel is a grouping of frequencies that is 6 MHz wide. For example, VHF channel 4 has a range of from 66 to 72 MHz. Frequency assignments for each channel have been handed down by the FCC and a TV station must transmit all of its audio and video within the limits of this 6 MHz wide channel.

   E. Cathode Ray Tube (CRT)--It was the invention of this tube that made TV possible. The CRT is a special type of vacuum tube. The outside is a thick glass envelope and on the inside of the front of this envelope is a phosphorus screen. In the back of the CRT is an electron gun. This gun traces a pattern back and forth across the front screen from top to bottom. As the gun traces across, it shoots a beam of electrons and as it traces back the electron beam is blanked out. The movement across the screen is called "trace" and the movement back is called "retrace".

   F. Camera--This is an electronic device containing a special type of light sensitive vacuum tube. The camera converts an optical image, created by light striking a lens, into an electrical signal, known as a video signal.

G. Audio--That portion of a TV signal that has to do with the sound.

H. Video--That portion of a TV signal that has to do with the picture.

II. TV Signal Propogation

A. Information Source--In TV there are two divisions of information sources; audio and video.

1. Audio--As in radio the main source of audio information is the microphone. Other sources of audio information would be the sound track of a film, a phonograph, an audio tape playback unit or the audio portion of a video tape.

2. Video--The primary source of video information in TV is the TV camera. Other sources would be a film projector, a slide projector, or the video portion of a video tape.

B. Encoder or Transmitter--In TV there is not one simple device that constructs and transmits the signal due to the fact that there are two signals to deal with. The signal is constructed in the following manner.

1. Audio--The audio signal is sent from the source to a mixing board in the audio control room where it is amplified and sent on to the master control room. Switching circuits in the mixing board make it possible to select which signal from the audio sources will be sent to master control. The audio control room is also where special effects such as reverb are added to the audio signal.

2. Video--The video signal from the camera is sent to the video switches in the video control room. The signal from each camera is displayed on a separate video monitor so that the program producer can select which signal will be sent to the master control room. The video control room is also where video special effects, such as split screen and fades, are added to the video signal.

3. Master Control Room--This is the nerve center of the TV station. All the audio and video signals converge here and are modulated onto RF carrier waves, 4.9 MHz apart, and sent, either by cable or microwave to the main transmitter where they are amplified and transmitted through cable or via an antenna.

III. Message Channel

A. Open Circuit--An open circuit transmission channel is where the transmitted signal is radiated via an antenna into the atmosphere.

B. Closed Circuit--A closed circuit transmission channel is where the transmitted signal is sent through cable and is not radiated into the atmosphere.

IV. Television Signal Detection

A. Decoder or Receiver--The TV signal is picked up from the atmosphere by an antenna and sent via a cable to the tuning section of the TV receiver. The tuning section determines which channel of frequencies will be allowed to pass through the receiver. Next the audio and video signals are separated from their carriers, amplified and sent on toward their final destination.

B. Information Destination--Due to the fact that there are two signals there are two destinations. The audio signal ends up at a speaker and the video signal is sent to a CRT (commonly called the picture tube) where a picture is formed on the face of the screen.

V. Uses of Television

A. Commercial--As in radio commercial TV derives its name and its operating funds from paid advertising. Commercial TV provides the whole range of programming and is broadcast through the atmosphere where anyone can receive the signals.

B. Cable (CATV)--For areas of poor reception CATV companies put up a TV antenna on a high hill or tall building and customers pay a monthly subscription to be connected via cable to this antenna.

C. Public television--Public TV is much the same as public radio. It is privately funded and mostly educational in programming. Public TV signals are broadcast through the atmosphere.

D. Security--Closed circuit TV cameras are used frequently to monitor places that need close supervision. The advantage of closed circuit TV for this function is that one security guard can monitor many places at once from one location.

E. Scientific--Television cameras can go where it is sometimes not practical or safe for man to go. Some examples are: 1) cameras in outer space, 2) cameras used to monitor thermonuclear detonations, 3) under water observation and, 4) cameras for observing the inside of a containment building at a nuclear power plant. Scientific uses of television are almost limitless.

F. Educational--By using closed circuit TV and video tape recorders it is possible to record almost anything and play it back later for educational purposes. Some examples are: 1) lectures, 2) scientific experiments, 3) political and other types of speeches, and 4) surgery (for medical students).

G. Recreational and Personal--There is an ever increasing number of video games on market today. The home video tape recorder and playback unit has made it possible to record material off of a TV set and play it back at leisure. Some ham radio operators use TV to see as well as talk to each other.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheet and go through outline of material giving demonstrations as you go.

V. Discuss student activity sheets.

VI. Give test.

VII. Plan field trip to TV station. (Suggested)

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Take field trip. (Suggested)

REFERENCES/RESOURCES

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3. Buban, Peter; Schmitt, Marshall, Technical Electricity and Electronics, New York, New York: McGraw-Hill, Inc. 1972.
4. Buban, Peter; Schmitt, Marshall, Understanding Electricity and Electronics, New York, N.Y.: McGraw-Hill, Inc. 1969, 2nd Ed.
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6. Stoddard, Edward, The First Book of Television, New York, NY, Franklin Watts, Inc., 1955.
7. Buchheimer, Naomi, Let's Go to a Television Station, New York, NY, G.P. Putnam's Sons, 1958.
8. Meyer, Jerome S., Picture Book of Radio and Television, New York, NY, Lothrop, Lee & Shepard Co., Inc., 1951.

Resources:

1. Information Sheets
2. Transparency Masters
3. Demonstrations
4. Activity Sheets

Terms and Definitions:

1. Audio--Pertains to sound portion of a TV signal.

2. Camera, TV--Complex electronic device used to convert an optical image formed by a lens into an electrical signal.

3. Channel--Band of frequencies, 6 MHz wide.

4. CRT--Abbreviation for Cathode Ray Tube; a special type of tube in which an electron beam can be focused on a luminescent screen to produce a visible pattern.

5. Signal, TV--A composite electrical signal consisting of both audio and video information.

6. Television--A communication system for transmission of images of fixed or moving objects usually accompanied by sound.

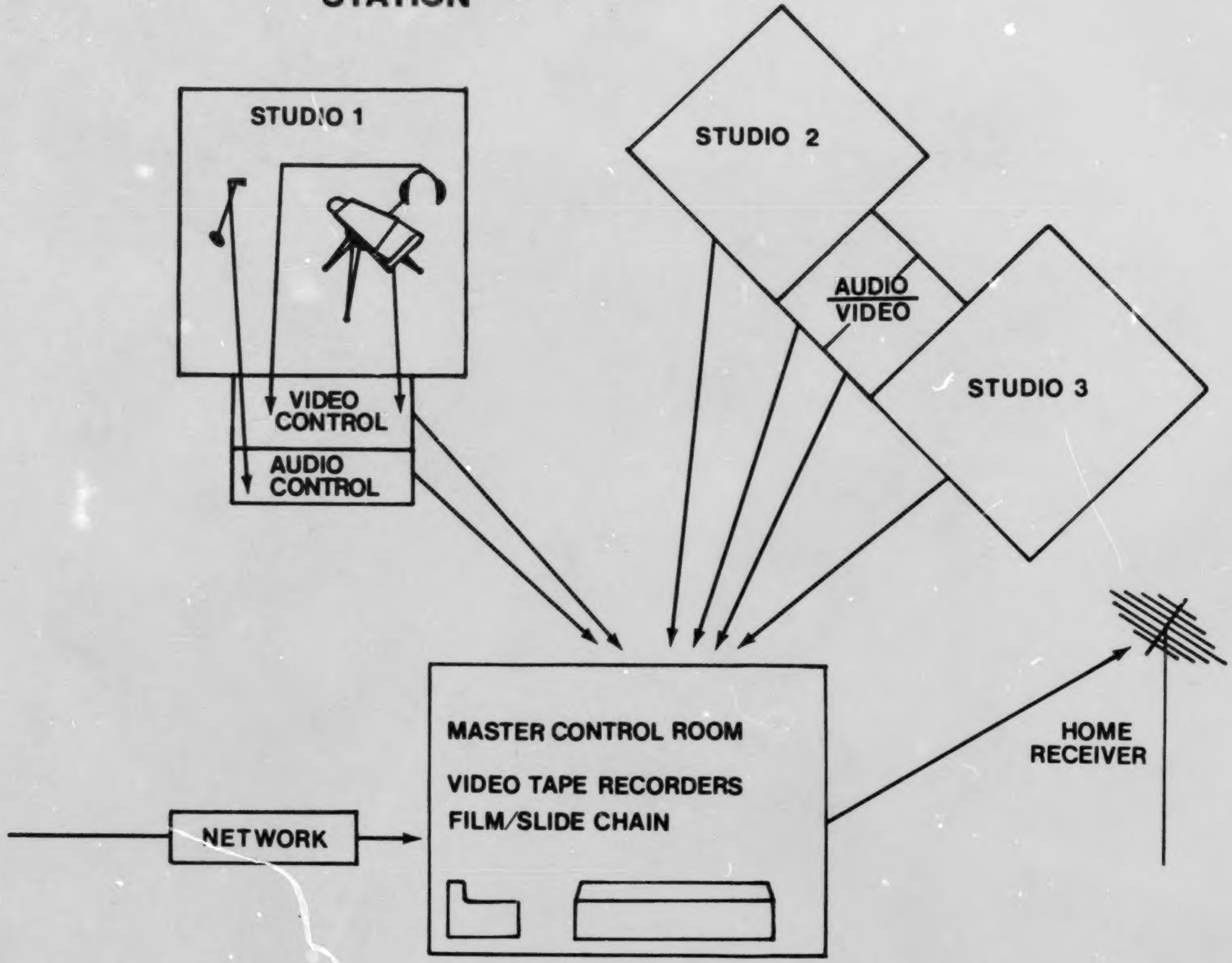
7. UHF--Stands for ultrahigh frequencies.

8. VHF--Stands for very high frequencies.

9. Video--Pertains to the picture portion of a TV signal.

10. VTR--Stands for video tape recorder.

TELEVISION BROADCASTING STATION



STUDIO 1

VIDEO CONTROL

AUDIO CONTROL

STUDIO 2

AUDIO
VIDEO

STUDIO 3

MASTER CONTROL ROOM

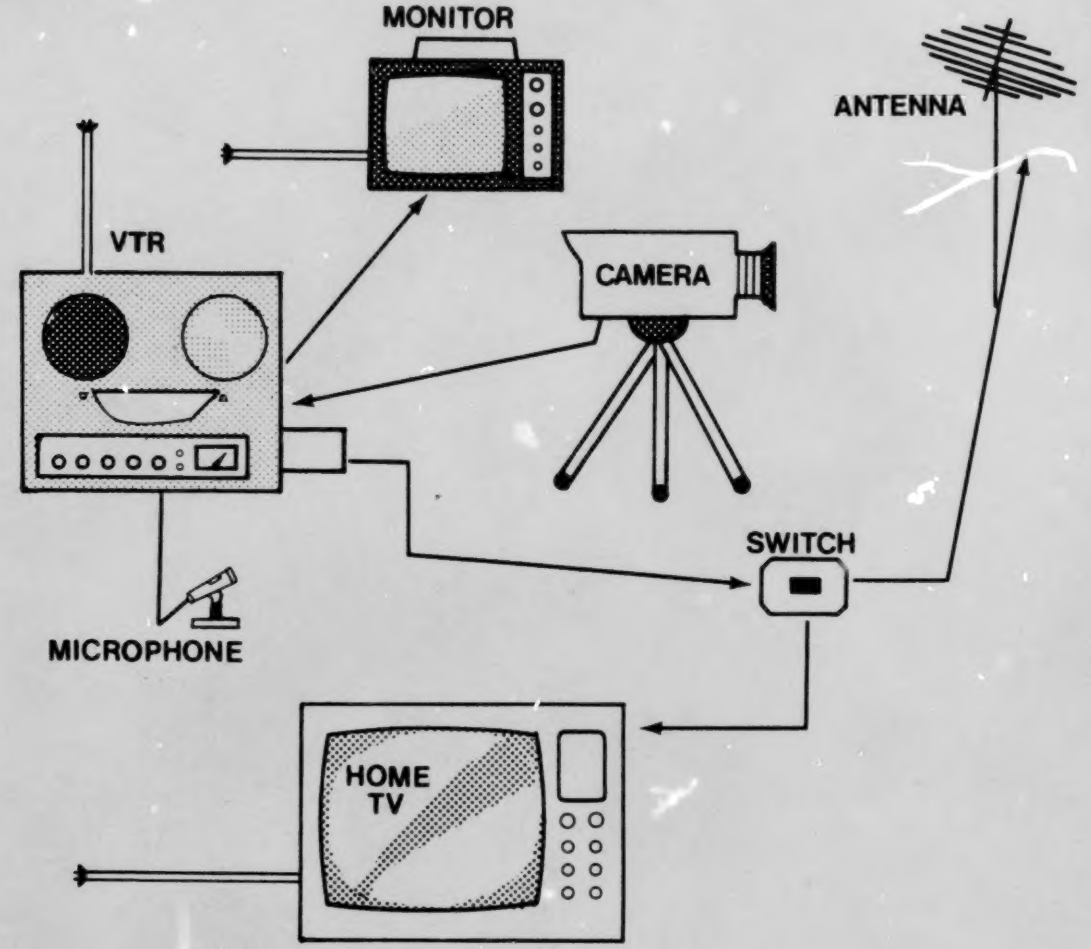
VIDEO TAPE RECORDERS

FILM/SLIDE CHAIN

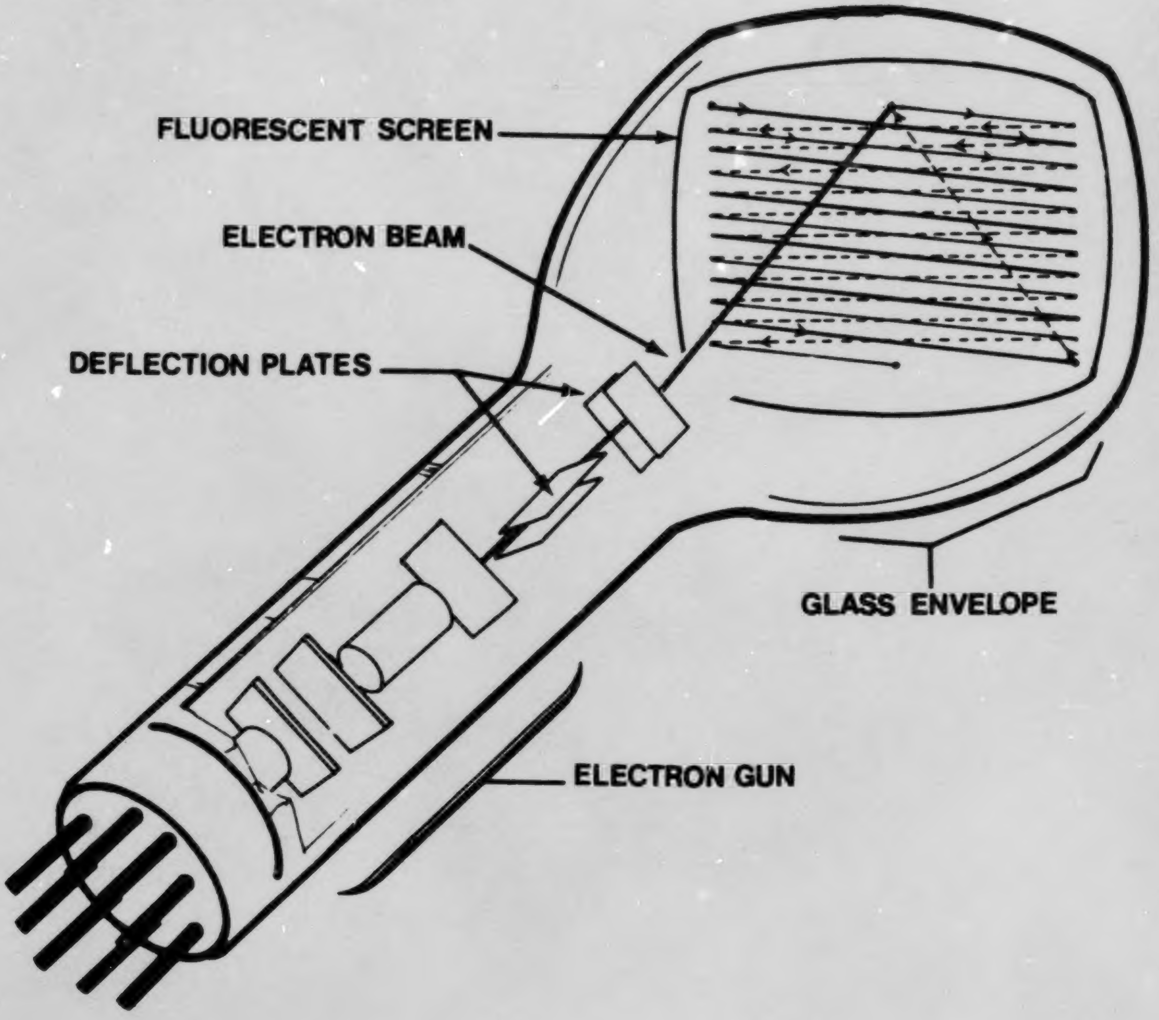
NETWORK

HOME RECEIVER

TYPICAL HOME CLOSED-CIRCUIT TELEVISION SYSTEM


MONITOR
ANTENNA
VTR
CAMERA
SWITCH
MICROPHONE
HOME TV

CATHODE-RAY TUBE


FLUORESCENT SCREEN
ELECTRON BEAM
DEFLECTION PLATES
GLASS ENVELOPE
ELECTRON GUN

Demonstration #1

USES OF TELEVISION

Objective:

To show some of the uses of television.

Materials:

1. 1 TV set
2. 1 video game
3. 1 video tape recorder
4. 1 portable TV camera

Procedure:

1. Demonstrate the video game and allow students to operate it.
2. Demonstrate the VTR by recording something from the TV set and replaying it.
3. Connect the TV camera to the VTR and record some action, and then play it back.

Student Activity #1

TELEVISION PRODUCTION

(for entire class or groups)

Objective:

To produce a TV commercial or news spot.

Materials:

1. 1 TV set
2. 1 video tape recorder
3. 1 portable TV camera

Procedure:

1. Connect all pieces of equipment.
2. Select people to be camera operator, actor(s), producer, VTR operator, etc.
3. Write a script.
4. Tape the spot.
5. Play it back.
6. Retape if there are large mistakes.
7. Alternate positions and retape.

SUGGESTED TEST

True or False:

T F 1. UHF stands for ultrahigh frequency.

T F 2. The TV signal consists of both audio and video information.

T F 3. CRT stands for cathode ray tube.

T F 4. The picture tube in a TV set is a VTR tube.

T F 5. A TV channel is 6 KHz wide.

T F 6. Audio pertains to the sound in television.

T F 7. The signal from a TV camera in a TV studio goes directly to the master control room.

T F 8. Audio special effects are added in the master control room.

T F 9. The video control room is the nerve center of a TV station.

T F 10. CATV stands for cable television.

ANSWERS TO TEST

1. T
2. T
3. T
4. F
5. F
6. T
7. F
8. F
9. F
10. T

EQUIPMENT/SUPPLIES

Equipment:

1. 1 TV set
2. 1 video game
3. 1 video tape recorder
4. 1 portable TV camera

Supplies:

1. 1 tape for video tape recorder

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

ELECTRICITY/ELECTRONICS

Title of Unit:

PRE-TEST/POST-TEST
MASTER REFERENCE LIST
MASTER EQUIPTMENT AND SUPPLIES LIST

PRE-TEST/POST-TEST

Matching:

A. Television
B. Atom
C. Resistance
D. Anode
E. Coaxial
F. AM
G. Proton
H. Video
I. Molecule
J. Current
K. Volt
L. Radio
M. Communication
N. Watt
O. Electron
P. Audio
Q. Channel
R. Conductor
S. Electron flow
T. Telegraph
U. Capacitor
V. Modulation
W. Laser
X. Broadcast
Y. Audio frequency
Z. FM
AA. Microwave
BB. Telephone
CC. Battery
DD. Ohm
EE. Teletypewriter
FF. Conventional flow
GG. Key
HH. Speaker
II. Cathode

_____ 1. A device used to transform incoherent light of various frequencies into a very narrow, intense beam of coherent light.

_____ 2. Pertains to picture portion of a TV signal.

_____ 3. Modulation where the amplitude of the carrier wave is modulated.

_____ 4. Electroacoustic device.

_____ 5. Frequencies that can be heard by the human ear.

_____ 6. Unit of measurement of resistance.

_____ 7. Theory that states that electrons move from an area of negative charge to an area of positive charge.

_____ 8. System of communication employing the transmission and reception, through the atmosphere, of images of fixed or moving objects, usually accompanied by sound.

_____ 9. Flow of electrons through a conductor.

_____ 10. Smallest particle of a compound.

_____ 11. Communications system that employs a code for the transmission and reception of signals.

_____ 12. Special type of cable that is shielded against outside interferences.

_____13. System of communication using electromagnetic waves for the transmission and reception of signals through the atmosphere.

_____14. Common name for a positive electrode.

_____15. Radio or television transmission intended for public reception without payment to the station.

_____16. Communications system used for transmitting and receiving sound waves produced by the human voice to and from distant points primarily over wire.

_____17. Pertains to sound portion of a TV signal.

_____18. Material through which electrons can flow easily.

_____19. Process of exchanging ideas and information.

_____20. A telegraph instrument with a signal activated device for automatically typing received messages and a keyboard for sending messages.

_____21. Term applied to radio waves in the frequency range of 1000 MHz and above.

_____22. Two pieces of conducting material separated by a piece of insulating material.

_____23. This is modulation where the frequency of the carrier wave is modulated.

_____24. Band of frequencies 6 MHz wide.

_____25. The process by which the intelligence is impressed onto the carrier wave.

_____26. Two or more cells.

_____27. Hand operated switch used to open and close a circuit.

_____28. Fundamental unit of negative charge.

_____29. Opposition to current flow.

_____30. Unit of measurement of electrical power.

True or False:

_____31. The FCC is the Florida Citrus Commission.

_____32. The first FM station in this country was WSM-FM.

_____33. Thomas Edison invented the radio.

_____34. 100 to 200 ma. of current produces a fatal heart condition known as ventricular fibrillation.

_____35. The symbol for current is C.

_____36. A solar cell is an example of the photoelectric effect.

_____37. Any current carrying conductor has an electromagnetic field around it.

_____38. Ohm's law states that one watt of electrical power is equal to one volt moving one coulomb of charge in one second.

_____39. Some resistors are color coded to determine their value.

_____40. The transistor is a solid state device.

_____41. The formula for Watt's law is: P = I x E.

_____42. Capacitance opposes a change in voltage.

_____43. Most static noise in radio is caused by a faulty tuning section.

_____44. In a radio, demodulation takes place in the transmitter.

_____45. Public radio is funded by paid commercial advertising.

_____46. One disadvantage of FM radio is the amount of noise that interfers with the signal.

_____47. The telegram is the primary service of Western Union.

_____48. The Bell System is the largest privately owned telecommunications system in the world.

_____49. There are 75 channels in the UHF television band.

_____50. All phone calls go through a central office.

ANSWERS TO TEST

1. W
2. H
3. F
4. HH
5. Y
6. DD
7. S
8. A
9. J
10. I
11. T
12. E
13. L
14. D
15. X
16. BB
17. P
18. R
19. M
20. EE
21. AA
22. U
23. Z
24. Q
25. V
26. CC
27. GG
28. O
29. C
30. N
31. False
32. True
33. False
34. True
35. False
36. True
37. True
38. False
39. True
40. True
41. False
42. True
43. False
44. False
45. False
46. False
47. False
48. True
49. False
50. True

EE 8.6

MASTER REFERENCE LIST

1. Brinton, Henry, The Telephone, John Day Company, New York, NY, 1962. (j654.1 B85)

2. Harrison, George R., Lasers, Franklin Watts, Inc., New York, NY, 1971. (j621.366 H319)

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10. Ress, Etta Schneider, Signals to Satellites, Mankato, Minnesota, Creative Educational Society Inc., 1965. (j384)

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14. Stoddard, Edward, The First Book of Television, New York, NY, Franklin Watts, Inc., 1955. (j654)

15. Buchheimer, Naomi, Let's Go to the Telephone Company, New York, NY, G.P. Putnam's Sons, 1958. (j654.1)

16. Hogben, Lancelot, The Wonderful World of Communication, Garden City, New York, Doubleday and Company Inc., 1969.

MASTER EQUIPMENT/SUPPLIES

Equipment:

1. 1 microammeter
2. 1 milliammeter
3. 1 pair pliers
4. 1 heat source (cigarette lighter will suffice)
5. 1 solar cell (Calectro #J4-804 or equivalent—under $10.00, 1979)
6. 2 bar magnets
7. 1 kilowatt-hour meter (if available)
8. 24 VOM meters
9. 24 DC power sources or 6 volt dry cell batteries
10. 48 test leads with clips on each end
11. 24 SPST switches
12. 1 buzzer (doorbell type)
13. 1 transformer (for buzzer)
14. 1 telegraph code key
15. 1 telephone (dial type)
16. 1 telephone (touch-tone type)
17. 1 TV set
18. 1 video game
19. 1 video tape recorder
20. 1 portable TV camera

SUPPLIES

1. 2 apples
2. 2 pennies
3. 2 nickels
4. 1 razor blade or equivalent sharp object

5. 2 12" pieces (#14 or larger) of 2 different types of wire (ex: copper and aluminum)
6. 1 small bottle of iron filings
7. 100 feet bell wire
8. 1 piece of 3/8" steel rod or bolt, 4" long
9. 1 roll of plastic electrical tape
10. 24 1/4 watt 200 ohm resistors
11. 24 1/4 watt 20 ohm resistors
12. 48 resistors of any size and value
13. Several resistors of various types and sizes
14. Several capacitors of various types and sizes
15. Several inductors of various types and sizes
16. Several transistors of various types and sizes
17. Several integrated circuits of various types and sizes
18. 1 Radio Shack AM transmitter kit #28-209)
19. 1 Radio Shack Solar-Powered AM radio kit #28-214
20. 24 Radio Shack crystal AM radio kits #28-207
21. 1 piece of wood 6" x 12" x 1"
22. 12" of a single pair of telephone wires
23. 12" of a multipair cable
24. 12" of a coaxial cable
25. 12" of coaxial line
26. 1 tape for video tape recorder

COMMUNICATIONS

JOB STRUCTURE: RADIO AND TELEVISION

JOB TITLE: Television Director D.O.T. No.: 159 067 014

Major Job Function:

Interprets script, conducts rehearsals, and directs and integrates all audio and visual elements of television program.

Job Duties:

1. Rehearses cast and establishes pace of program to stay within time requirements.
2. Informs technicians of scenery, lights, props, and other equipment desired.
3. Approves scenery, costumes, choreography, and music.
4. Issues instructions to technicians from control room during telecast to keep them informed of effects desired such as dissolves, long shots, medium shots, superimpositions, fade-ins or fade-outs.

JOB TITLE: Announcer D.O.T. No.: 159 147 010

Major Job Function:

Announces radio and television programs to audience.

Job Duties:

1. Memorizes script, reads, or ad-libs to identify stations, introduce and close shows, and announce station breaks, commercials, or public service information.
2. Cues worker to transmit program from network central station or other pick-up points according to schedule.
3. Reads news flashes to keep audience informed of important happenings.

JOB TITLE: Disk Jockey D.O.T. No.: 159 147 014

Major Job Function:

Announces radio program of musical selections.

Job Duties:

1. Selects phonograph or tape recording to be played based on program specialty and knowledge of audience taste.
2. Comments on music and other matters of interest to audience, such as weather, time, or traffic conditions.

JOB TITLE: Radio Director D.O.T. No.: 159 167 014

Major Job Function:

Directs rehearsals and broadcasts of several radio programs.

Job Duties:

1. Selects cast, musicians, and other performers.
2. Integrates various parts of program to produce entertainment balance.
3. Rehearses cast to elicit best possible performance.
4. Establishes pace of program to stay within time requirements.
5. Cues announcers and technicians to insert spot announcements or commercials.

JOB TITLE: Station Manager D.O.T. No.: 184 117 062

Major Job Function:

Directs and coordinates activities of radio or television station.

Job Duties:

1. Supervises directly, or through subordinates, personnel engaged in departments, such as sales, program, engineering, and personnel.
2. Observes activities to insure compliance with federal regulations.
3. Develops plans to promote sales of programs and the periods to advertisers and their agencies.
4. Negotiates with motion picture companies for purchase of independent film programs.
5. confers with owners to discuss station policy and administrative procedures.

JOB TITLE: Program Director D.O.T. No.: 184 167 030

Major Job Function:

Plans programming for radio or television stations or network.

Job Duties:

1. Determines type, length, and time of each program, including commercial announcements and newscasts as well as entertainment.
2. Purchases program from independent producers.
3. Confers with motion picture director and producer to solve production or casting problems.

JOB TITLE: Transmitter Operator D.O.T. No.: 193 262 038

Major Job Function:

Operates and maintains radio transmitter to broadcast radio and television programs.

Job Duties:

1. Moves switches to cut in power to units and stages of transmitter.
2. Monitors lights on console panel to ascertain that components are operative and that transmitter is ready to emit signal.
3. Turns controls to set transmitter of FM, AM, or TV frequency assigned by Federal Communications Commission.
4. Monitors signal emission and spurious radiations outside of licensed transmission frequencies assigned other stations.
5. Notifies broadcast studio when ready to transmit.
6. Observes indicators and adjusts controls to maintain constant sound modulation and insure that transmitted signal is sharp and clear.
7. Maintains log of programs transmitted as required by the Federal Communications Commission.
8. Tests components of malfunctioning transmitter to diagnose trouble, using test equipment, such as oscilloscope, voltmeters, and ammeters.
9. Disassembles and repairs equipment, using hand tools.

JOB TITLE: Audio Operator D.O.T. No.: 194 262 010

Major Job Function:

Controls audio equipment to regulate volume level and quality of sound during television broadcasts, according to script and instructions of technical director.

Job Duties:

1. Directs worker in placing microphones in locations that insure quality of sound reproduction.
2. Cuts microphones in, and blends output of individual microphones by adjustiong volume, fader, and mixer controls.
3. Monitors audio signals by earphone, loudspeaker, and by observing dials on controls panel to verify quality of sound reproduction.

Audio Operator Job Duties (continued):

4. Sets keys, switches, and dials to synchronize sound with picture presentation.
5. Obtains tapes, records, and themes from library according to program schedule.
6. Operates turntables and tape recording machines to reproduce music and appropriate audio sounds for specific programs.

JOB TITLE: Video Operator D.O.T. No.: 194 282 010

Major Job Function:

Controls video console to regulate transmission of television scenes including test patterns and filmed and live black-and-white or color telecast.

Job Duties:

1. Views action on television monitor and sets switches and observes dials on console to control framing, contrast, brilliance, color balance, and fidelity of image being transmitted.
2. Moves switches to change scenes being televised in separate studios fading one scene into the next as specified by script.
3. Monitors on-the-air programs to insure technical quality of broadcast.
4. Previews program to be used next to determine that signal is functioning and that program will be ready at required time.
5. Maintains log on studio to transmitter microwave link.

JOB TITLE: Recording Engineer D.O.T. No.: 194 362 010

Major Job Function:

Operates disk or tape recording machine to record music, dialog, or sound effects of phonograph recording sessions, radio broadcasts, television shows, training courses, or conferences, or to transfer transcribed material to sound-recording medium.

Job Duties:

1. Threads tape through recording device or places blank disk on turntable.
2. Moves lever to regulate speed of turntable.
3. Places cutting stylus or record.
4. Examines grooves during cutting by stylus to determine if grooves are level, using microscope.
5. Turns knobs on cuting arm to shift or adjust weight of stylus and cause grooves to be cut evenly.
6. Starts recording machine and moves switches to open microphone and tune in live or recorded programs.
7. Listens through earphone to detect imperfections of recording machines or extraneous noises emanating from recording studio or production stage.
8. Observes dials, mounted on machine, to insure that volume level and intensity remain within specified limits.
9. Removes filled reel or completed recordings from machine and attaches identifying labels.
10. Keeps record of recordings in log book.

JOB TITLE: Technical Director D.O.T. No.: 962 162 010

Major Job Function:

Coordinates activities of radio or television studio and control-room personnel to insure the technical quality of pictures and sound for programs originating in studio or from remote pickup points.

Job Duties:

1. Plans and arranges for special effects requested by supervisory.
2. Assigns work to technical personnel engaged in controlling and maintaining lights, audio and video control equipment, microphones, and cameras.

Technical Director Job Duties (continued):

3. Observes picture through monitor and gives instruction to video operator concerning shading or camera operator concerning composition desired.

4. Controls switcher-mixer unit to switch cameras, fade from one picture to another or superimpose one image upon another as indicated by script or as cued by program director.

JOB TITLE: Film Editor D.O.T. No.: 962 264 010

Major Job Function:

Edits motion picture film, television video tape, and sound.

Job Duties:

1. Evaluates and selects scenes in terms of dramatic and entertainment value and story continuity.

2. Trims film segments to specified lengths and reassembles segments in sequence that presents story with maximum effect.

3. Reviews assembled film on screen and makes corrections.

4. Confers with supervisory personnel and others concerning filming of scenes.

JOB TITLE: Light Technician D.O.T. No.: 962 362 014

Major Job Function:

Sets up and controls lighting equipment for television broadcast or motion picture production.

Job Duties:

1. Confers with directors and studies script to determine lighting effects required.

2. Sets up spot, floor, incandescent, and mercury vapor lights, reflectors, and other equipment.

Light Technician Job Duties (continued):

3. Switches lights on during broadcast, following script or instructions from directors.

4. Makes minor repairs, such as replacing broken cables on equipment.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

DRAFTING

Title of Unit:

ARCHITECTURE

DESCRIPTION OF UNIT

This unit contains a brief history of Drafting with an introduction to Architectural Drafting and a presentation on the 16th inch ruler or scale.

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify general and Architectural Drafting terms, and participate in a discussion of the history of Drafting and its function in Architecture. The student will exhibit a working knowledge of the 16th inch ruler (or scale).

PERFORMANCE OBJECTIVES

After completion of this unit, the student will be able to:

1. Answer questions with 80% accuracy over the history of Drafting with emphasis on Architectural Drafting and how Drafting functions as a technical communications media.
2. Possess a working knowledge of the 16th inch standard ruler.
3. Exhibit knowledge of general drafting and Architectural Drafting terminology and techniques.

OUTLINE OF CONTENT

I. Brief History of Architectural Drafting

Even in ancient times, men drew pictures to show others what they had in mind. Only drawings give the directions that are easy for builders to follow.

Some of the earliest builders made crude sketches on clay tablets that still exist. It is probable that they also made detailed plans of their buildings on parchment or papyrus, but we have not found any fragments of such drawings. The people of Mesopotamia used drafting materials as early as 2200 B.C. A statue of one of their kings, Gudea shows him with a drawing of a building on his lap.

Ancient Egyptian stone masons made plans for the pyramids and other buildings on papyrus, slabs of limestone and sometimes wood. They may have used large wooden T-squares, 8 or 10 ft. long, to draw the lines on the ground for the first layer of big stone blocks. Sailors of ancient Greece and Rome made rough maps of the world they knew. Perhaps they drew pictures and plans for their buildings, aqueducts and forts.

For centuries men struggled with the problem of drawing solid objects on flat surfaces. It was difficult to show accurately the dimensions of length, width, and height on drawings of two dimensions. Progress was slow until Leonardo da Vinci, an Italian genius of the fifteenth century (1452-1519), made a study of drawing and painting. His sketches were easy to understand and for several years he taught others his methods. After his death, other Europeans continued da Vinci's studies, but his teachings were not published until 1651. Among these scholars were mathematicians who explored different ways to show exact measurements on their drawings. Gradually they found how to draw more accurate pictures of the things they wanted to make. Gaspard Monge (1746-1818) a Frenchman of Napoleon's time, discovered the principles from which the system we use today has been developed. for some time his methods were considered a military secret.

Americans can take pride in the wide use they make of this pictorial language and in the advances they contribute to the art. George Washington and his officers used drawing instruments. In drafting history we can see the plans that Thomas Jefferson made for Monticello, his beautiful home in Virginia. At the United States Military Academy, where every cadet learns to express his ideas of roads, bridges, machines, buildings, military operations, and so on in a pictorial way, another French scholar, Claude Crozet, taught Monge's projection methods of drawing for the first time in this country. American teachers and engineers added to Crozet's work and further developed this pictorial language. West point graduates, among whom were the first trained engineers of our country, have often contributed to our technical progress. They have drawn pictures and plans for some of our railroads, bridges, public buildings, light- houses, canals, and atomic energy plants.

We usually find it difficult, and in most cases impossible, to describe in words the appearance of the things we want to make or build. Since words fail to give a complete or acurate description, we use pictorial sketches, drawings, diagrams, and photographs. Today there is hardly a newspaper, magazine, catalogue, or book without them.

Photographs are often used today to show what an object looks like. We also use perspective drawings to show an object as it appears to our eyes. However, such drawings and photographs do not show the exact shape and size of all the details of an object. A photograph or a perspective drawing does not show the inside parts or the exact way in which the pieces fit together. We need antoher kind of drawing to show this information.

Drawings that are known as projection drawings give exact details with accurate measurements. They provide the builder or manufacturer with the exact description that he needs to build what the designer has in mind. Projection drawings are more widely used than any other type of drawing. To make such a drawing, we view and draw an object from different sides. We draw its shape and the outline of its parts. We use different types of lines according to definite rules. We make the lines exact lengths (or proportional lengths), and we add measurements to show their true lengths. In this way, we project each view of the object onto our drawing paper.

We study drafting and the rules of projection drawing so that we cannot only make accurate drawings of our own, but also understand the drawings of others. May of the troubles of the world are caused by the fact that various people do not understand one another. The infinite number of languages and dialects that contributed to this condition resulted from a lack of intercommunication of peoples widely separated in various parts of the world. Even today when communication is so greatly improved, the progress toward a world language is painfully slow-so slow, indeed, that we cannot foresee the time when it will be a fact.

Although men have not been able to get together on a world language of words and sentences, there has actually been a universal language in use since the earliest times: the graphic language. The idea of communicating thoughts from one person to another by means of pictures occurred to even the earliest cave dwellers, and we have examples still in existence to prove it. These earliest men communicated orally, undoubtedly by grunts and other elementary sounds, and when they wished to record an idea, they made pictures upon skins, stones, walls of cave or whatever materials they could find. As already stated the earliest forms of writing were through picture forms, such as the Egyptian hieroglyphics. Later, these forms were simplified and became the abstract symbols used in our writing today. Thus, even the letter character in present word languages have their basis in drawings.

A drawing is a graphic representation of a real thing, an idea, or a proposed design for construction later. Drawings may take many forms, but the graphic method of representation is a basic natural form of communication of ideas that is universal and timeless in character.

DD 1.4

Man has developed graphic representation along two distinct lines, according to his purpose: (1) Artistic and (2) Technical. It is our purpose to deal with the technical area as a communication media.

Perhaps the first text on technical drawing in this country was Geometrical Drawing, published in 1849 by William Minifie, a high school teacher in Baltimore. In 1850 the Alteneder family organized the first drawing instrument manufacturing company in this country (Theo. Alteneder & Sons, Philadelphia). In 1876, the blueprint process was introduced in this country at the Philadelphia Centennial Exposition. Up to this time, the graphic language was more or less an art, characterized by fine-line drawings made to resemble copper-plate engraving, by the use of shades lines, and by the use of water color "washes." These techniques became unnecessary after the introduction of blueprinting of modern technical drawing. The graphic language now became a relatively exact method of representation, and the building of a working model as a regular preliminary to construction became unnecessary.

Up to about the turn of the nineteenth century throughout the world, drawings were generally made in what is called first-angle projection, in which the top view was placed under the front view, etc. At this time in the United States, after a considerable period of argument pro and con, practice gradually settled on the present third-angle projection in which the views were situated in what we regard as their more logical or natural positions. Today, third-angle projection is standard in the United States, but first- angle projections is still used throughout much of the world.

During the early part of the twentieth century, may books on the subject were published in which te graphic language was analyzed and explained in connection with its rapidly changing architectural design and applications.

Architectural drawings are concerned with the representation and specification of buildings and structures of various kinds. Although the general principles are the same as for other technical drawings, there are certain methods of representation, conventional symbols, and practices that are necessary because of the relatively small scale used for architectural plans.

In addition to working drawings, pictorial drawings are used to show how the completed structure will look. Such pictures together with preliminary or sketch plans present both exterior and interior features and arrangements and provide a basis for starting the working drawings.

However, before starting the working drawings, several preliminary drawings may need to be made for consideration of the general design, exterior appearance, and plan layout. These are gone over until they are satisfactory and meet with client's approval. Drawings such as seen in the transparencies (Numbers 1.24 thru 1.33 inc.) can then be made to clarify the whole design.

Working drawings are based upon orthographic projection (discussed later in section on Mechanical Engineering and then in more detail in section on Industrial Engineering) with dimensions and notes added.

Such drawings must conform in style with good practice as followed in the office where they are made. There must be contrast, which is obtained by giving proper values to the various lines that compose the views. Figures that are easy to read, uniform lettering, and the use of standard terms are essential. When completed, a working drawing must be thoroughly checked for errors and improvements before being submitted for approval.

II. Objectives in Drafting:

1. Accuracy: No drawing is of maximum usefulness if it is not accurate. The student must learn from the beginning that he cannot be successful in his college career or later in his professional employment if he does not acquire the habit of accuracy in his work.

2. Speed: "Time is Money" in industry, and there is no demand for the slow draftsman or engineer. However, speed is not attained by hurrying; it is an unsought by-product of intelligent and continuous work. It comes with study and practice, and the fast worker is usually mentally alert.

3. Legibility: The draftsman or engineer should remember that his drawing is a means of communication to others, and that it must be clear and legible in order to serve its purpose well. Care should be given to details, especially to lettering.

4. Neatness: If a drawing is to be accurate and legible, it must also be clean; therefore, the student should constantly strive to acquire the habit of neatness. Untidy drawings are the result of sloppy and careless methods, and will not be accepted by the instructor.

III. We will now consider the first objective in Drafting, Accuracy, and discuss the use of the 16th inch standard ruler. A presentation on measurement, its application and suggested evaluation procedures is presented in the form of an outline below.

IV. Presentation on 16th Inch Scale or Standard Ruler.

A. Measurement

1. Types of Scale of Measurement
   a. Basic or Architects Scale
   b. Engineers Scale
   c. Decimal Scale
   d. Metric Scale

2. Uses of Scales of Measurement
   a. Enlargement
   b. Reduction

3. Reading the Basic 16th Inch Scale
    a. Mock-up of 6" scale-visual Aid
        (1) Class participation

4. Architects Scale
    a. The 16th inch scale
        (1) Transparencies no. 1.34, 1.35, 1.36

B. Answer questions on lesson

V. Application:

A. Have students mark distance on handout using their ruler for evaluation before testing at next class meeting. Graded by student helper or teacher aid.

VI. Testing:

A. Will take form of dimensions to be measured and marked off on test, to occur at next class meeting.

B. Project: measure rooms at home or school. (To be completed as first a preliminary and then a completed Architectural sketch.)

VII. Terms and Definitions:

Architecture-The art or science of building buildings.

Architect--A person who designs buildings. The architect decides what the building will look like inside and outside. The architect decides how all the parts of the building will be arranged according to what kind of building it is and what it is going to be used for.

Architectural drafter--A person whose job is to draw pictures and plans of the architect's design ideas.

Architectural drafting--Makes uses of instruments with pencils and sometimes ink to draw the plans for the building contractor to go by in constructing the building.

Preliminary sketch--The architect's first design ideas for a house which he draws freehand, without using instruments. This unit will be concerned primarily with house design and will be done freehand like an architect's preliminary sketch.

Proportion--How one side looks compared to the other side, larger or smaller.

Sketching--Drawing freehand, without drafting instruments.

Square footage--The total area of a room or house obtained by multiplying the length times the width.

VIII. Form follows function is the basic rule of design.

This means that any man-made object is formed, shaped, designed according to its use. Example: a pitcher is a container with a handle and a spout. The container is shaped to hold water, the handle is shaped so that a hand can grasp it, and the spout is shaped to help the water pour where you want it to go.

IX. The basic rule of design applied to house design

In order to apply the basic rule of design to house design, you need to know the rooms needed in the house and briefly where they should be located.

1. Bedrooms--on the quiet side of the house.

2. Bathrooms--between or near bedrooms.

3. Kitchen--Easy access to driveway and near dining area.

4. Dining area--Next to kitchen.

5. Living area--Connects with dining area and bedroom.

6. Hallways--Limit to only what is necessary to connect other rooms.

X. Steps used in designing a small house

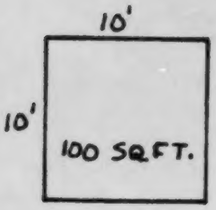
A. Figure square footage

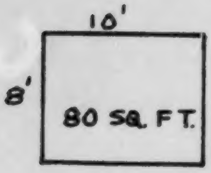
   1. Determine square footage of whole house.

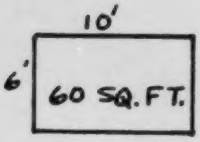
   2. Name and number of rooms with minimum and maximum square footage for each.

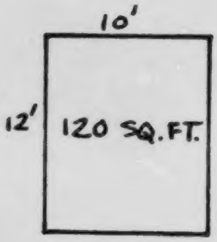
B. Preliminary sketch: arrange and fit the rooms needed into an area the size of the total area of the house. This is where you will use proportional sketching.

XI. Square footage is the total area of a room or house obtained by multiplying the length times the width. Examples:


10'
10'
100 SQ.FT.

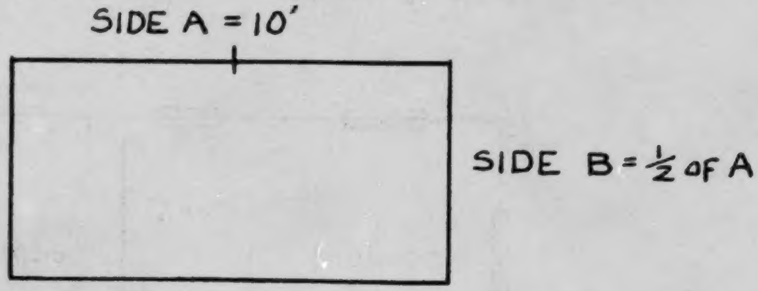




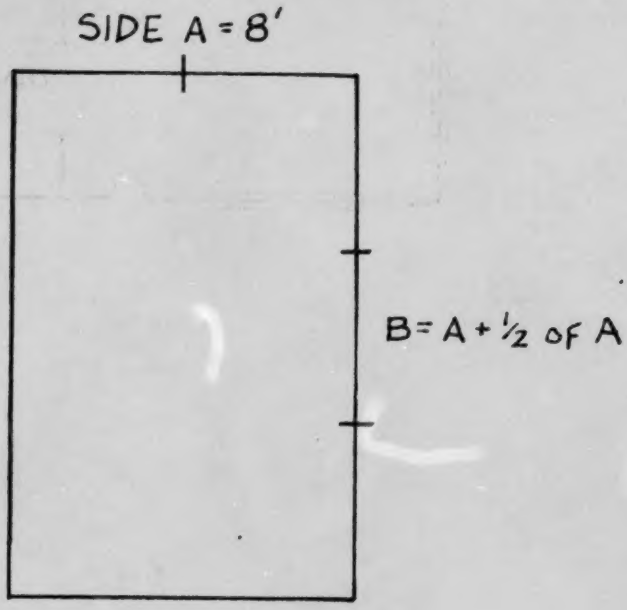

10'
12'
120 SQ. FT.

XII. Proportional sketching is done by estimating the length of the sides of a room by comparison. examples.

If side A is 10 feet long and you want side B to be 5 feet long, you make side B approximately 1/2 the length of side A.

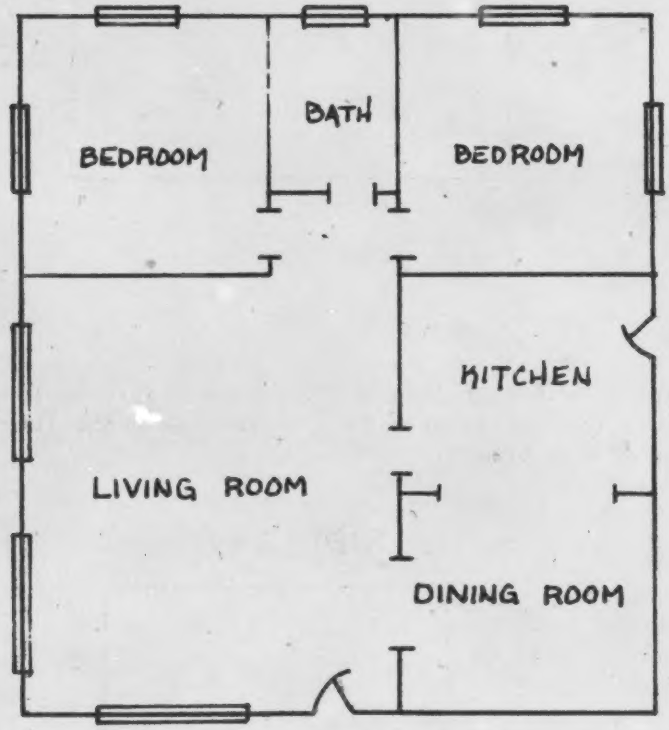


If side A is 8 feet long and you want side B to be 12 feet long, you estimate the middle of side A, make side B the length of side A plus 1/2 the length of side A.



XIII. Placement of windows and doors on preliminary sketch.

Allow approximately 3 feet for each door and normal window; small for a bathroom window and larger for a picture window, or two windows side by side. Doors and windows may be placed wherever needed and where there is enough space. To place windows, locate the center of where you want to place a window by the proportional sketching method and sketch the window to the left and right of this center location.


BATH
BEDROOM
BEDROOM
KITCHEN
LIVING ROOM
DINING ROOM

XIV. To draw a preliminary sketch floor plan, start by drawing square or rectangle representing the total square footage of the house. Decide on the number of rooms, the approximate size of these rooms and fit them into your square, keeping in mind the basic rule of design and how it is applied to house design.

TEACHER ACTIVITIES

I. Make transparencies. (If not provided)

II. Provide students with objective sheet.

III. Provide students with information, assignment sheets.

IV. Discuss unit and specific objectives.

V. Discuss information and assignment sheets.

VI. Show students examples of some basic floor plans.

VII. Teach the student by lecture, demonstration, and individual assistance how to do the assignments.

VIII. Give tests.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Take tests.

IV. Complete assignment sheets.

REFERENCES/RESOURCES

I. References

A. French and Svensen, Mechanical Drawing, New York, New York, McGraw Hill Brook Company, Inc., 1957.

B. Giespecke, Mitchell, Spencer and Hill, Technical Drawing, New York, New York, MacMillan Publishing Company, Inc., 1974.

C. Hepler, Donald E. and Paul I Wallach, Architecture, Drafting and Design. New York, McGraw Hill Book Company, Incorporated, 1965.

D. J. K. Lomax, Memphis City Schools.

II. Resources

A. Suggested Procedure

B. Information Sheet

C. Transparency masters

D. Activity sheets

SUGGESTED PROCEDURE

I. Give overview of the entire unit. Read and explain the Performance Objectives. Look at and explain information sheets and assignment sheets. Explain:

   A. Terms and definitions

   B. Show students some examples of simple basic floor plans. Transparencies numbers 1.24, 1.25, 1.26, 1.27, 1.28, 1.29, 1.30 1.31, 1.32, 1.33.

II. Briefly review and answer questions regarding I. Explain:

   A. 16th inch ruler

   B. Transparences Numbers 1.34, 1.35, 1.36

   C. Student activity No. 1

III. Briefly review and answer questions regarding II. Explain:

   A. Steps in designing a small house

   B. Explain and demonstrate on chalkboard square footage

   C. Student Activity Sheet #2

IV. Briefly review and answer questions from III Explain and demonstrate on chalkboard.

   A. Proportional sketching

   B. Student Activity Sheet #3

V. Explain

   A. Placement of windows and doors

   B. How to start preliminary floor plan sketch

Have students start trying to do Student Activity #4 under the instructor's supervision until student has a plan acceptable to the instructor.

On a piece of handout mimeograph paper, have student redraw the plan accepted by the instructor. Do this with best possible proportional sketching.

Add windows and doors to the redrawn plan.

Post test is the accepted preliminary sketch floor plan plus: Give the Unit Test.

INFORMATION SHEET #1

I. Brief History of Architectural Drafting

Even in ancient times, men drew pictures to show others what they had in mind. Only drawings give the directions that are easy for builders to follow.

Some of the earliest builders made crude sketches on clay tablets that still exist. It is probable that they also made detailed plans of their buildings on parchment or papyrus, but we have not found any fragments of such drawings. The people of Mesopotamia used drafting materials as early as 2200 B.C. A statue of one of their kings, Gudea shows him with a drawing of a building on his lap.

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Drawings that are known as projection drawings give exact details with accurate measurements. They provide the builder or manufacturer with the exact description that he needs to build what the designer has in mind. Projection drawings are mnore widely used than any other type of drawing. To make such a drawing, we view and draw an object from different sides. We draw its shape and the outline of its parts. We use different types of lines according to definite rules. We make the lines exact lengths (or proportional lengths), and we add measurements to show their true lengths. In this way we project each view of the object onto our drawing paper.

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DD 1.18

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INFORMATION SHEET #2
(CONT.)

III. The basic rule of design applied to house design

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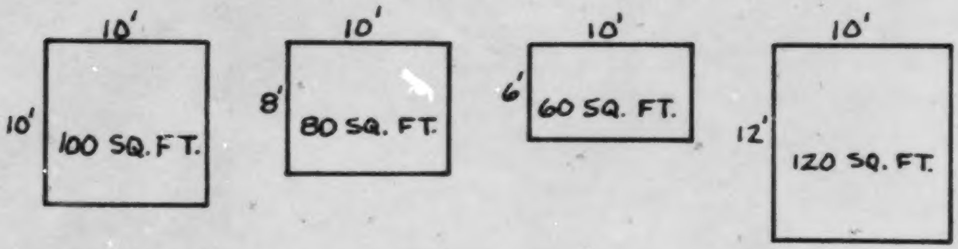

INFORMATION SHEET #2
(CONT.)

VI. Proportional sketching is done by estimating the length of the sides of a room by comparison. examples.

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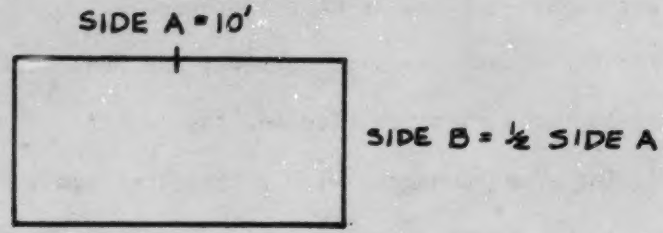
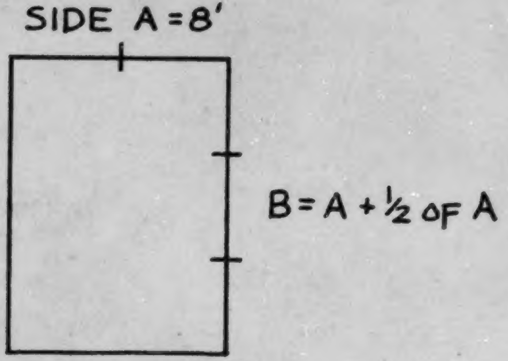


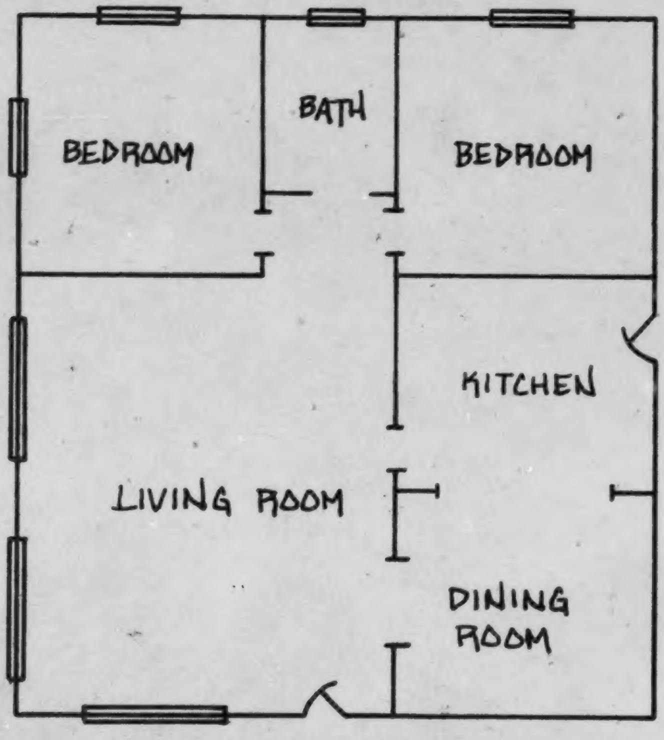
INFORMATION SHEET #2
(CONT.)

If side A is 8 feet long and you want side B to be 12 feet long, you estimate the middle of side A, make side B the length of side A plus 1/2 the length of side A.

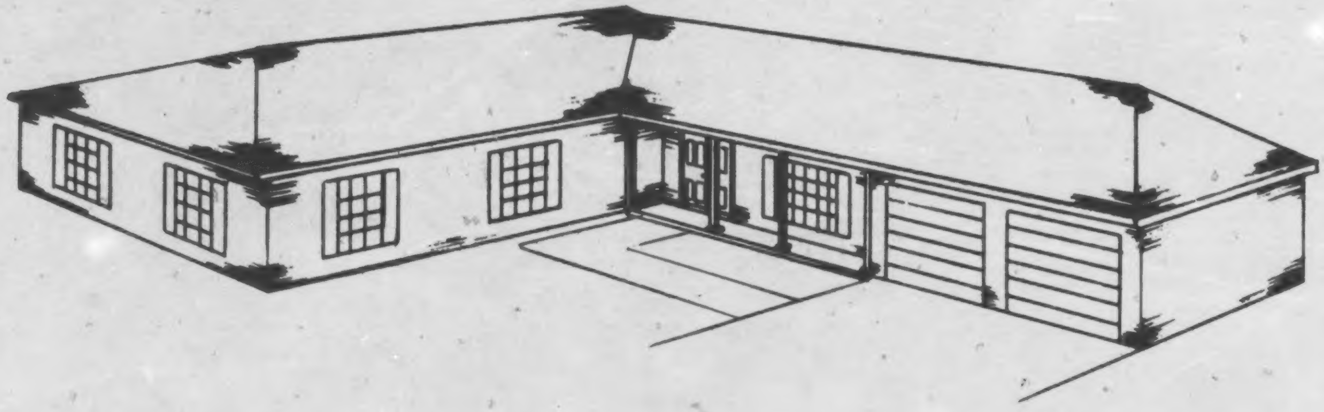


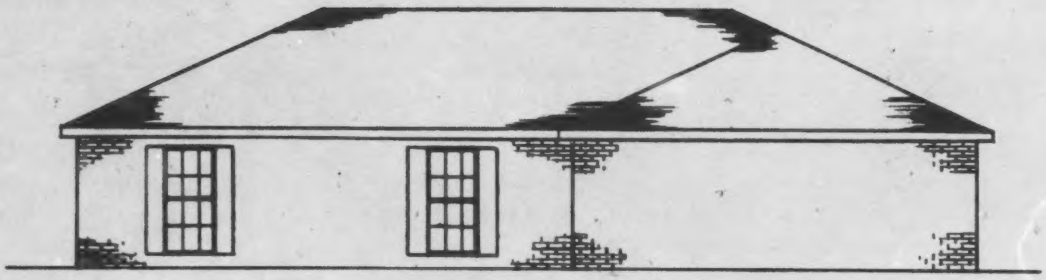
VII. Placement of windows and doors on preliminary sketch.

Allow approximately 3 feet for each door and normal window; small for a bathroom window and larger for a picture window, or two windows side by side. Doors and windows may be placed wherever needed and where there is enough space. To place windows, locate the center of where you want to place a window by the proportional sketching method and sketch the window to the left and right of this center location.

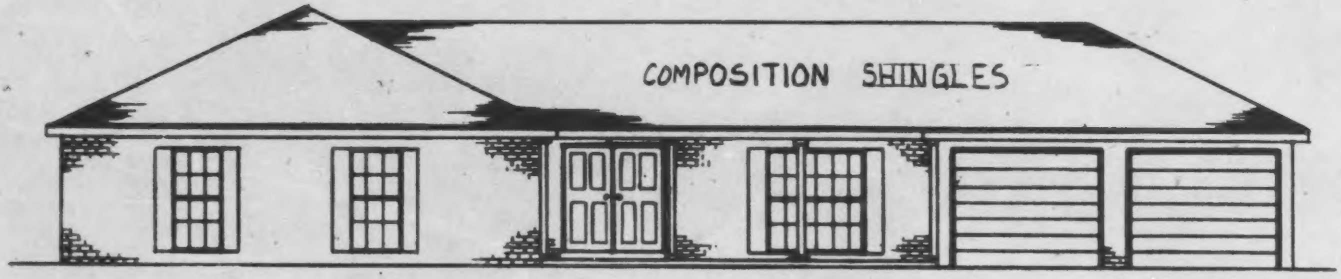


VIII. To draw a preliminary sketch floor plan, start by drawing square or rectangle representing the total square footage of the house. Decide on the number of rooms, the approximate size of these room and fit them into your square, keeping in mind the basic rule of design and how it is applied to house design.

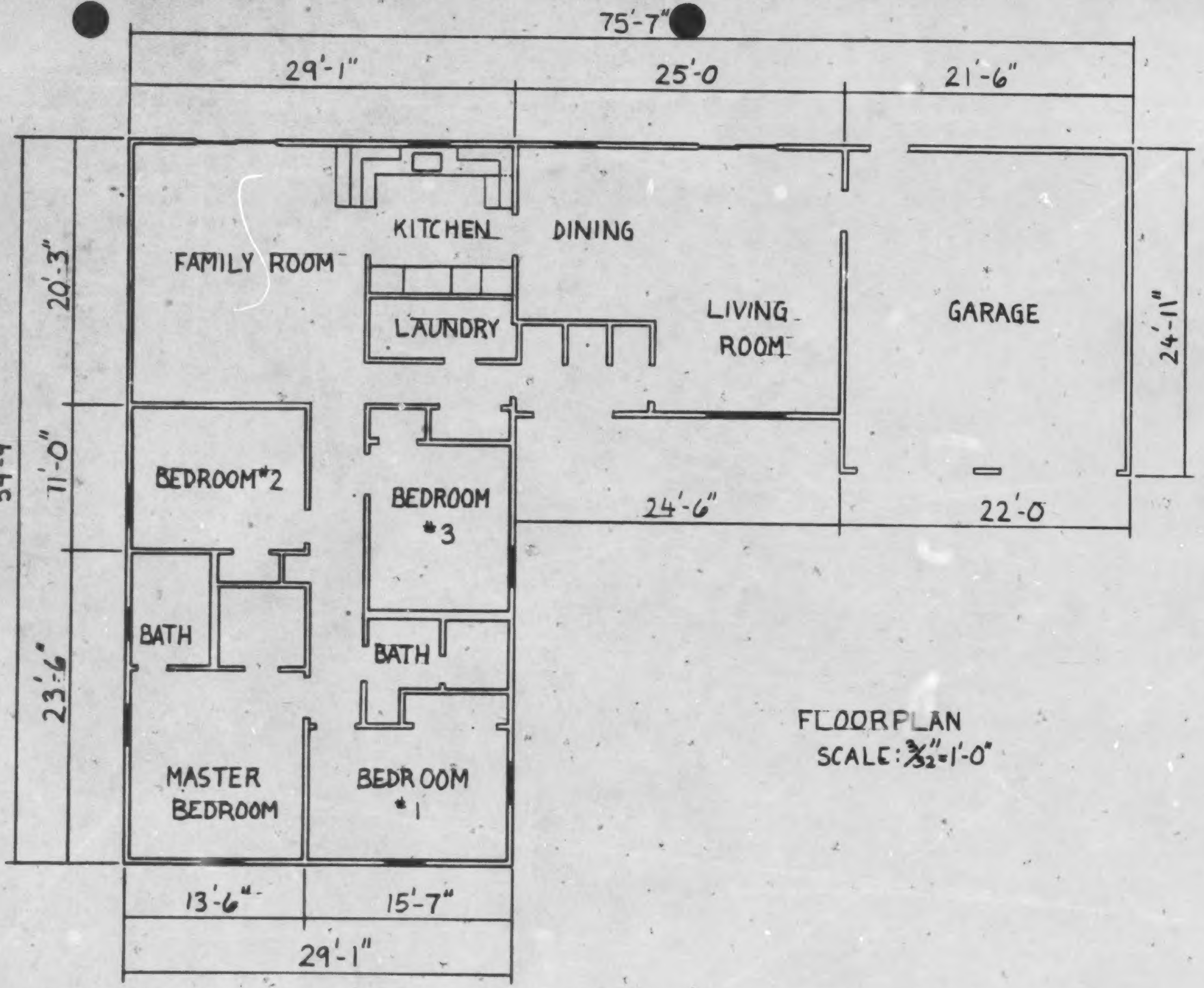




RIGHT SIDE VIEW
SCALE: 3/32" = 1'-0"

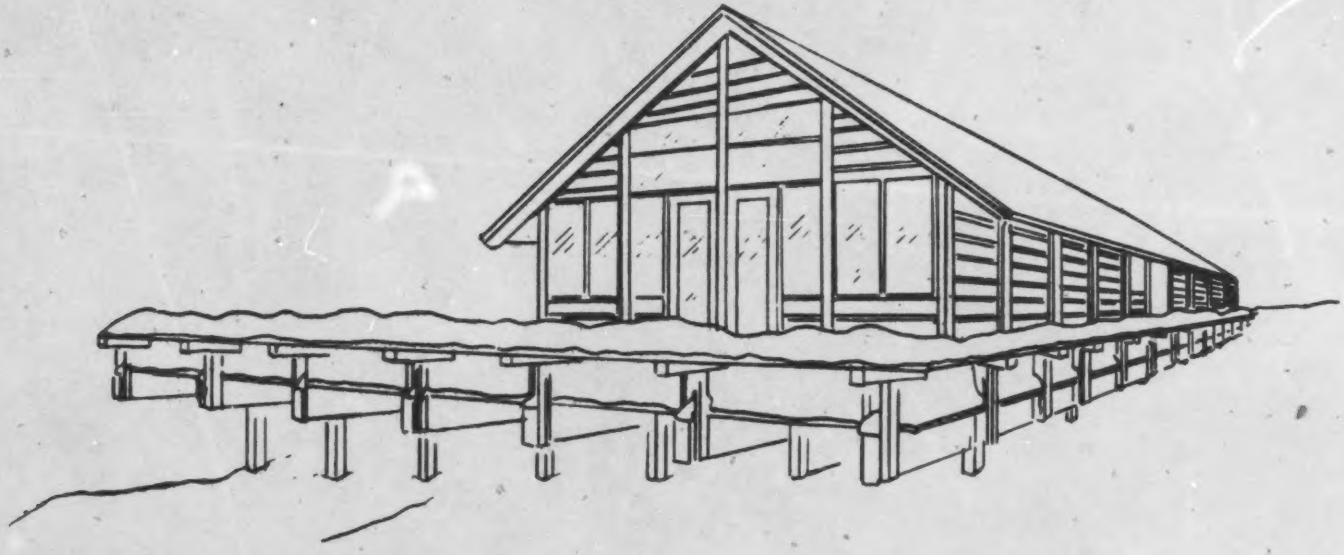

COMPOSITION SHINGLES

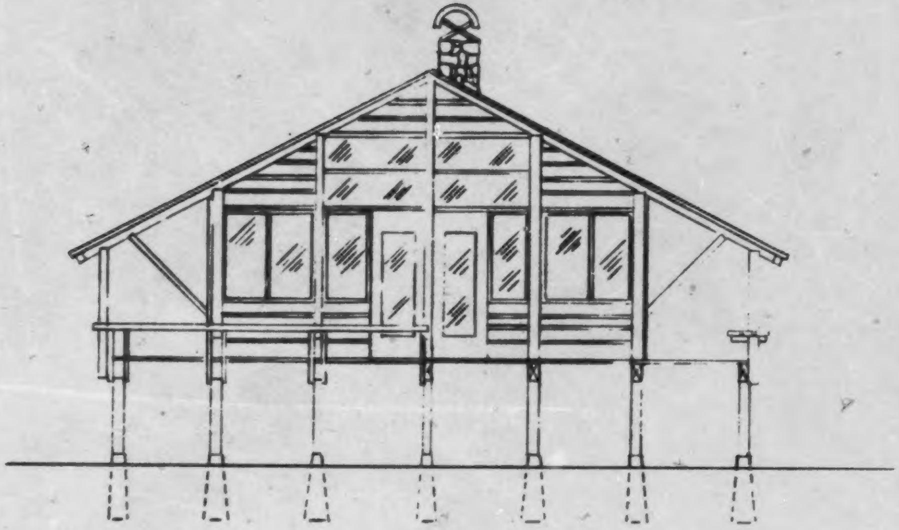
FRONT ELEVATION
SCALE: 3/32"-1'-0"


75'-7"
29'-1"
25'-0
21'-6"
KITCHEN
DINING
FAMILY ROOM
LAUNDRY
LIVING ROOM
GARAGE
20'-3"
54'-9"
11'-0"
23'-6"
24'-11"
BEDROOM #2
BEDROOM #3
24'-6"
22'-0
BATH
BATH
MASTER BEDROOM
BEDROOM #1
13'-6"
15'-7"
29'-1"

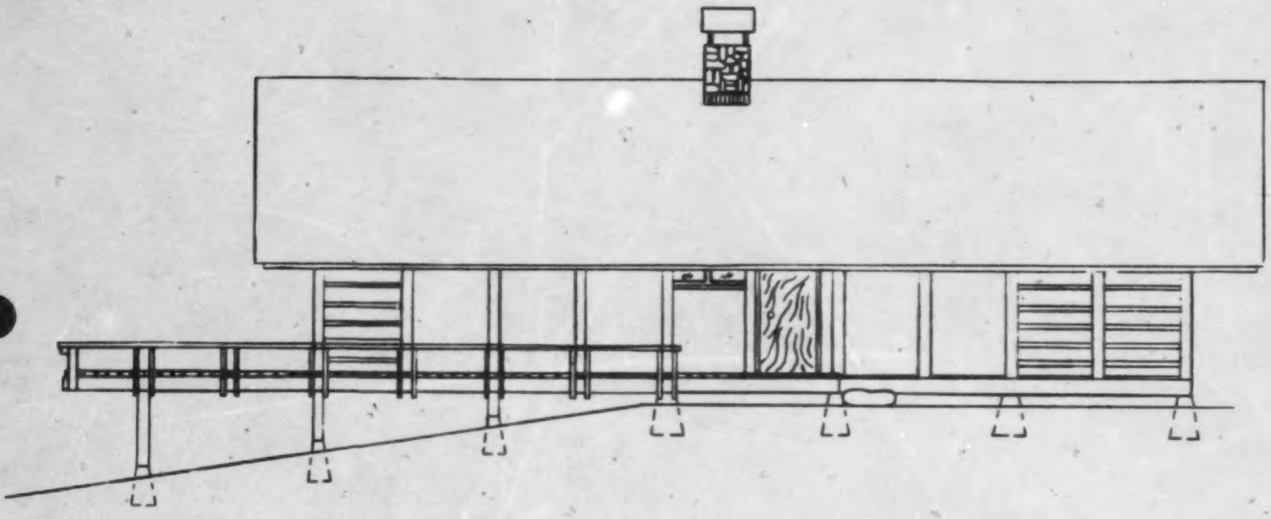
FLOORPLAN
SCALE: $\frac{3}{32}$"=1'-0"

T.M.-3 / DD 1.24-C

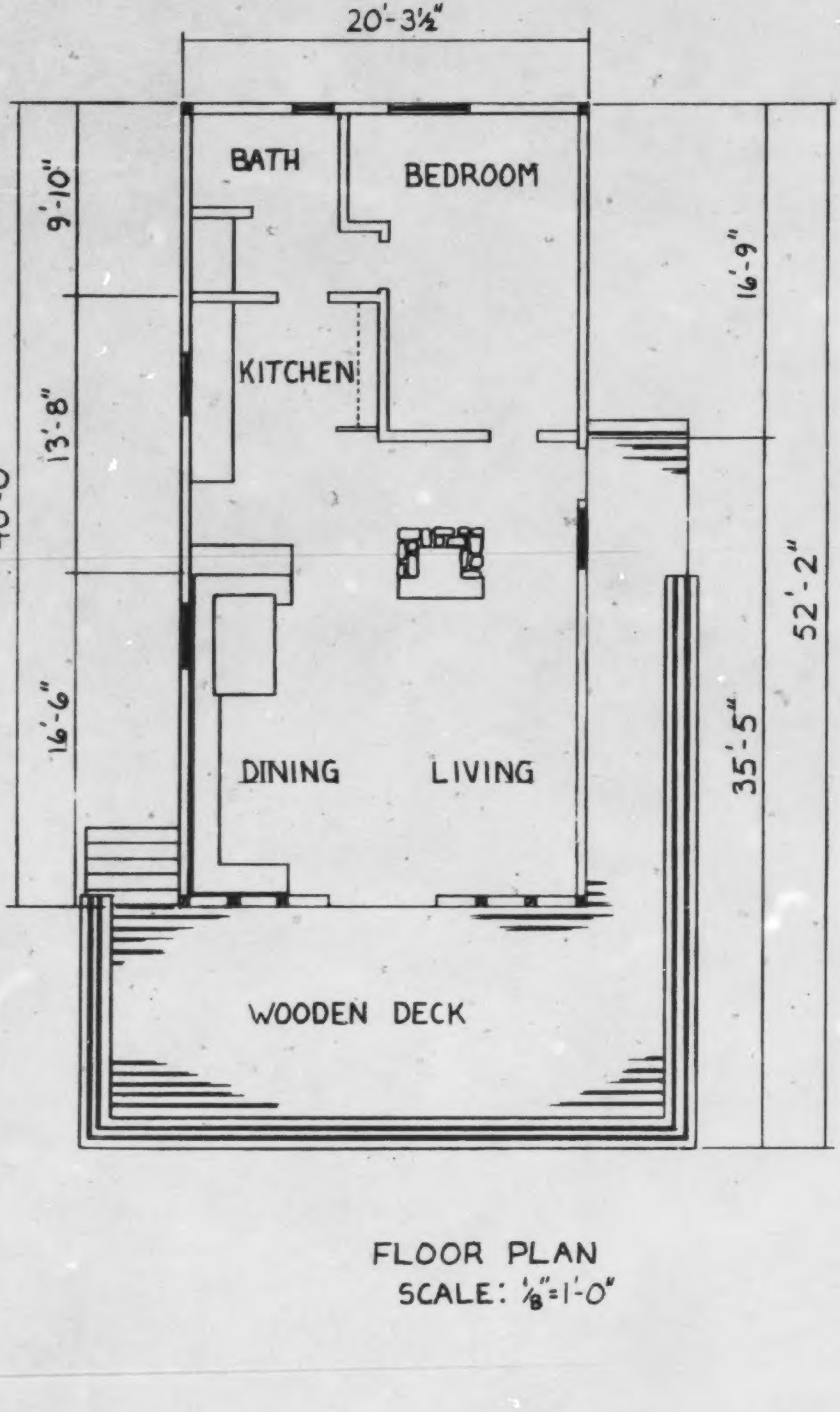




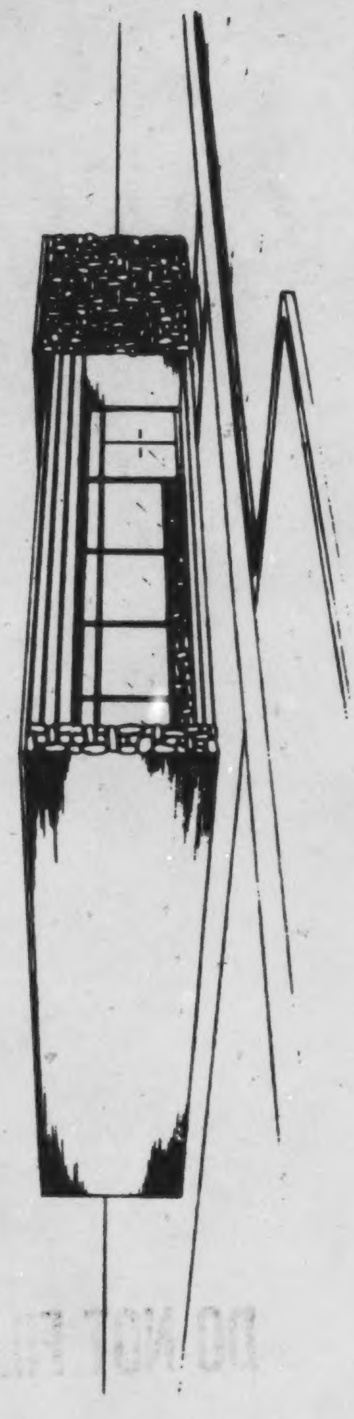
FRONT ELEVATION
SCALE: $\frac{1}{8}$"=1'-0"

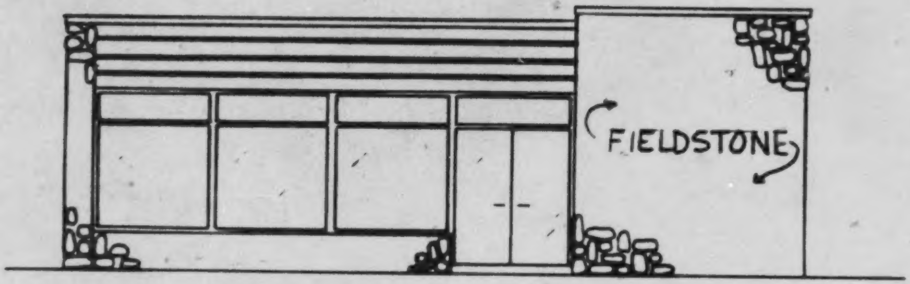


RIGHT SIDE ELEVATION
SCALE: $\frac{1}{8}$" = 1'-0"

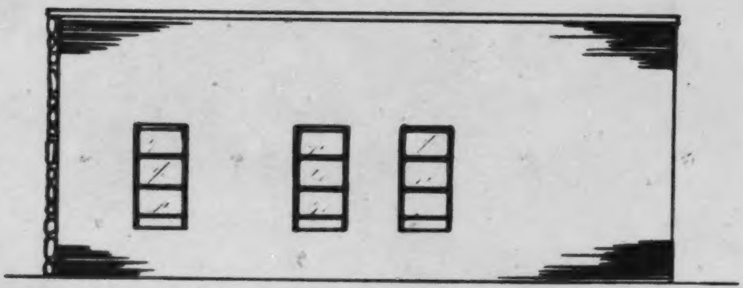

20'-3½"
BATH
BEDROOM
KITCHEN
DINING
LIVING
WOODEN DECK
9'-10"
13'-8"
16'-6"
40'-0"
16'-9"
35'-5"
52'-2"

FLOOR PLAN
SCALE: ⅛"=1'-0"

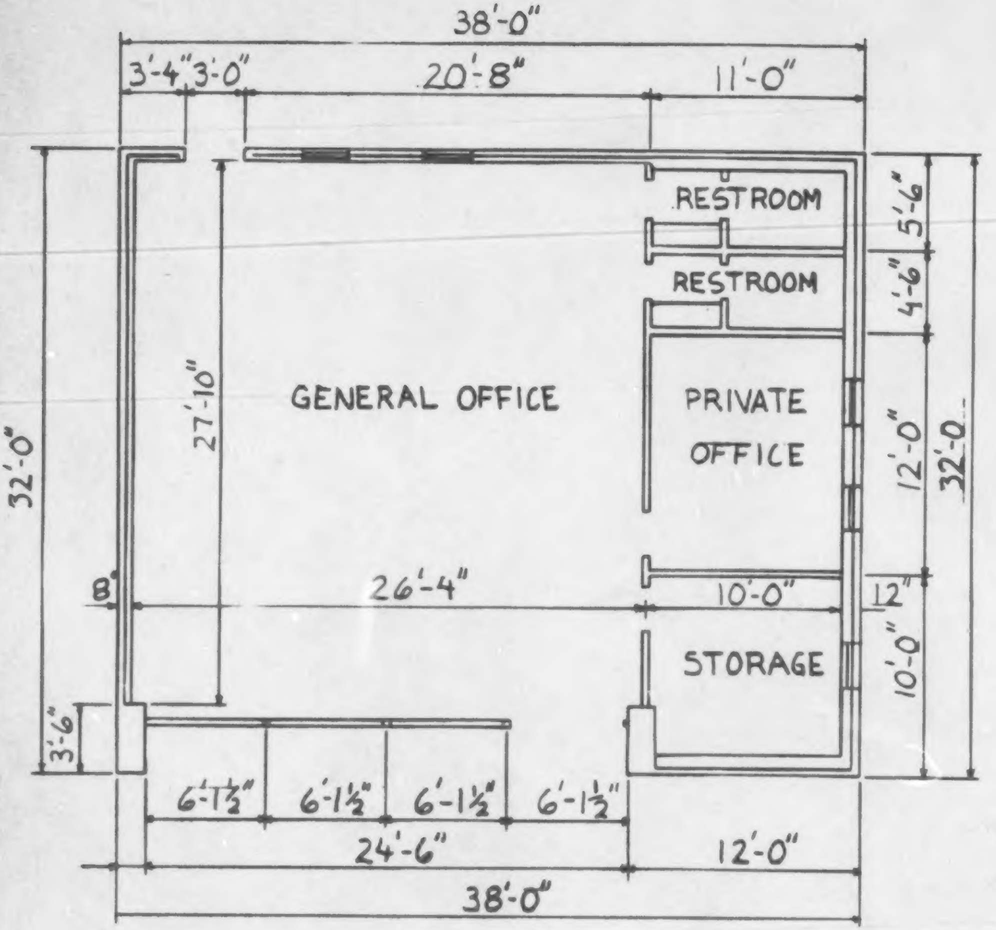



FIELDSTONE

FRONT ELEVATION
SCALE: 3/32"=1'-0"

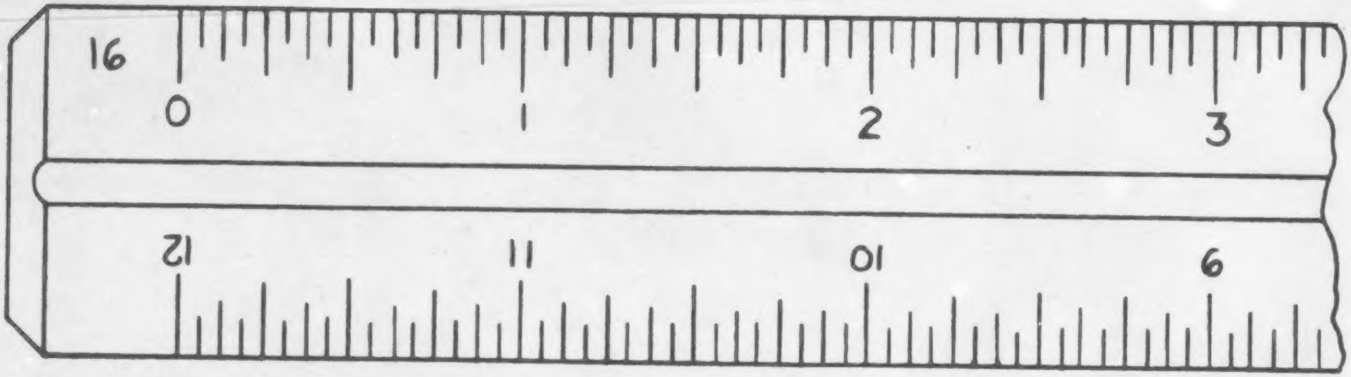


RIGHT SIDE ELEVATION
SCALE: 3/32"=1'-0"

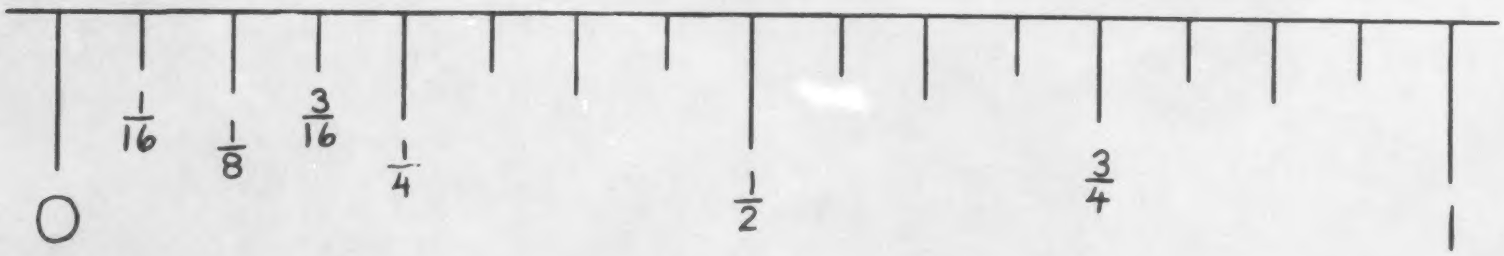

38'-0"
3'-4"
3'-0"
20'-8"
11'-0"
RESTROOM
RESTROOM
5'-6"
4'-6"
GENERAL OFFICE
27'-10"
32'-0"
PRIVATE OFFICE
12'-0"
32'-0
8"
26'-4"
10'-0"
12"
STORAGE
10'-0"
3'-6"
6'-1½"
6'-1½"
6'-1½"
6'-1½"
24'-6"
12'-0"
38'-0"

REAL ESTATE OFFICE
FLOOR PLAN SCALE: 3/32"=1'-0"

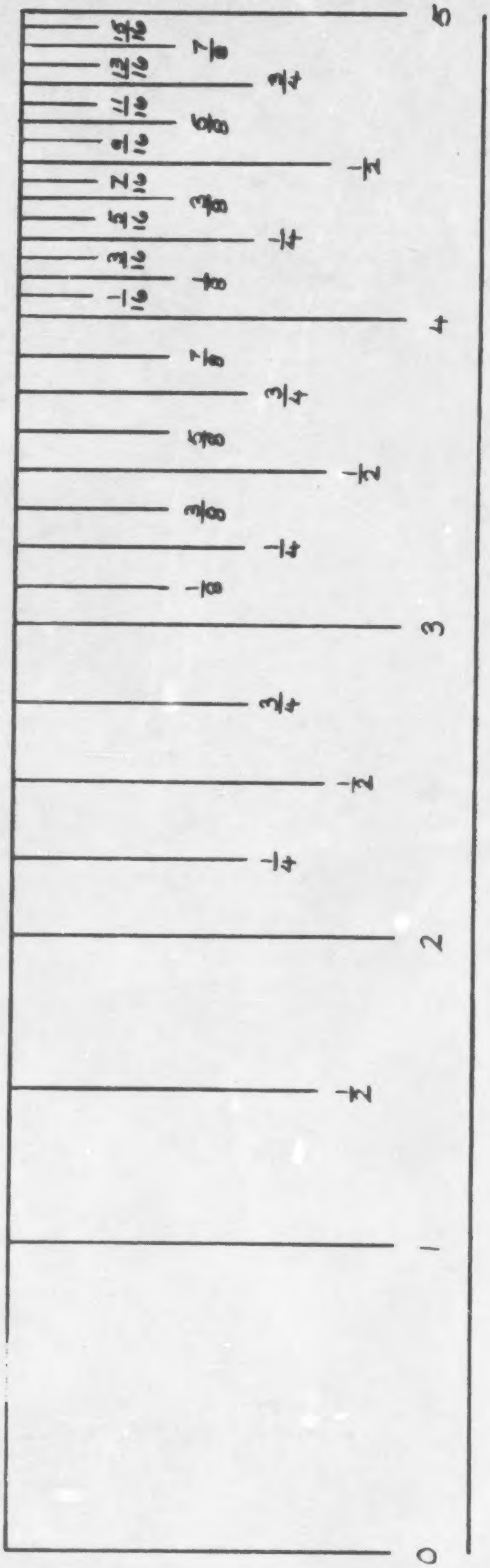
T.M.-10 / DD 1.24-J


16
0
1
2
3
12
11
10
9

SIXTEENTH INCH SCALE


0
$\frac{1}{16}$
$\frac{1}{8}$
$\frac{3}{16}$
$\frac{1}{4}$
$\frac{1}{2}$
$\frac{3}{4}$
1

ONE INCH OF SIXTEENTH INCH SCALE

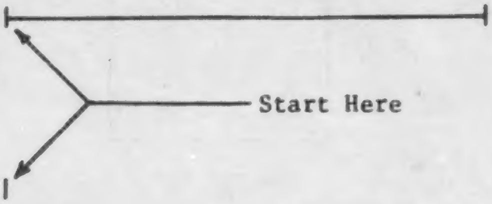

0
1
1/2
2
1/4
1/2
3/4
3
1/8
1/4
3/8
1/2
5/8
3/4
7/8
4
1/16
1/8
3/16
1/4
5/16
3/8
7/16
1/2
9/16
5/8
11/16
3/4
13/16
7/8
15/16
5

DD 1.25

STUDENT ACTIVITY NO. 1

Draw lines the following lengths:

Example: 2 3/4"



3 1/4" |

2 1/8" |

1 5/8" |

1 3/8" |

4 1/2" |

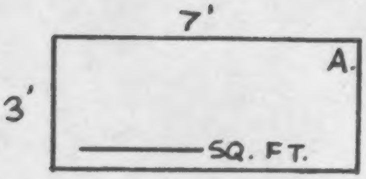
3 3/4" |

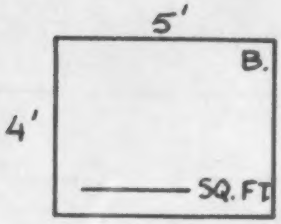
2 1/16" |

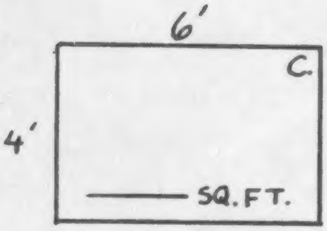
4 3/16" |

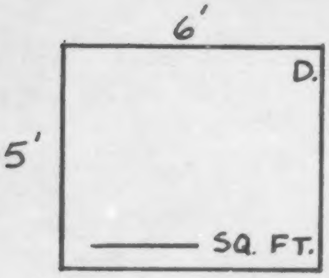
STUDENT ACTIVITY NO. 2

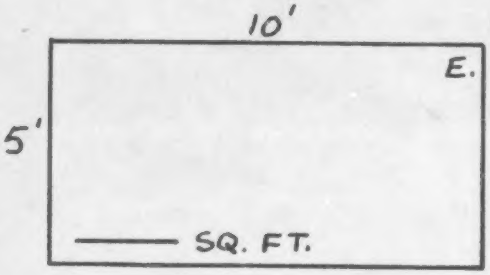
FIGURING SQUARE FOOTAGE

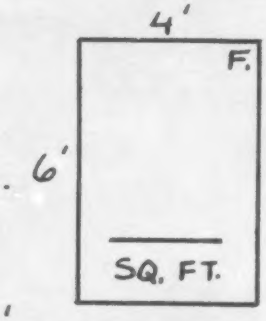


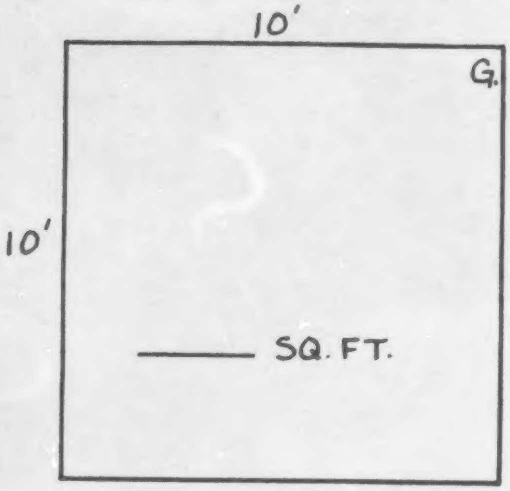


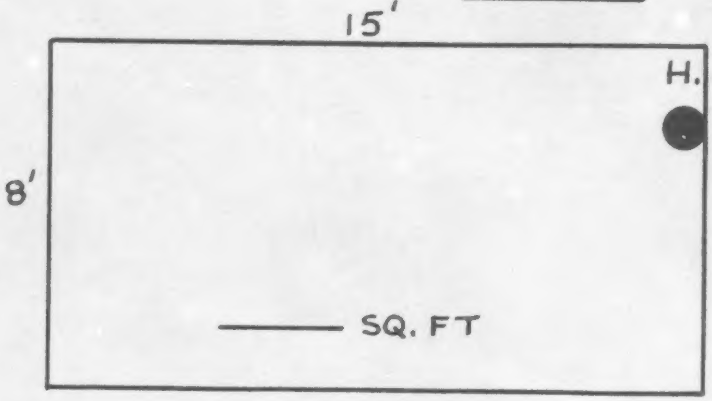


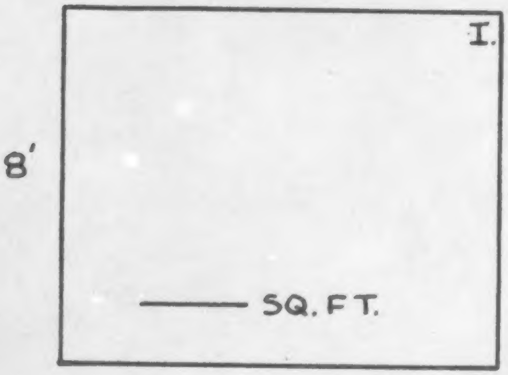


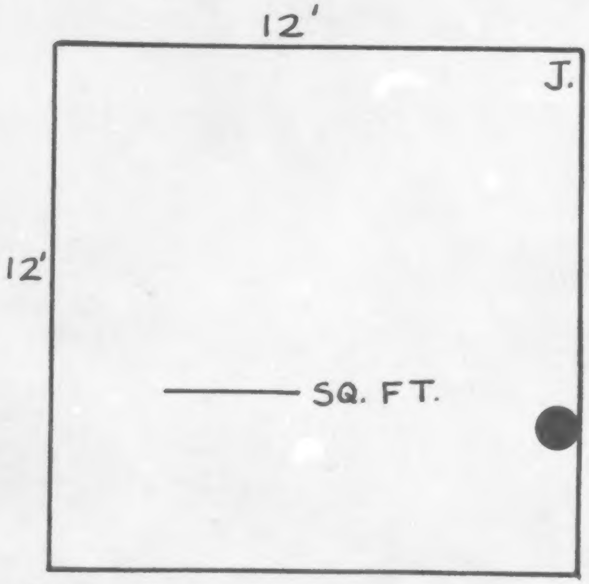












STUDENT ACTIVITY NO. 2*

*ANSWERS

FIGURING SQUARE FOOTAGE

A. 21

B. 20

C. 24

D. 30

E. 50

F. 24

G. 100

H. 120

I. 80

J. 144

STUDENT ACTIVITY NO. 3

Sketching Proportions

On a piece of newsprint or notebook paper, sketch some rooms whose proportions would look right for these square footage figures. Label your rooms A through J.

A. 3 x 7 = 21 square feet

B. 4 x 5 = 20 square feet

C. 4 x 6 = 24 square feet

D. 5 x 6 = 30 square feet

E. 5 x 10 = 50 square feet

F. 6 x 4 = 24 square feet

G. 10 x 10 = 100 square feet

H. 8 x 15 = 120 square feet

I. 8 x 10 = 80 square feet

J. 12 x 12 = 144 square feet

Compare the proportions of your rooms A through J with the proportions of rooms A through J on Student Activity Sheet 1.

STUDENT ACTIVITY NO. 4

Using the following information, make a preliminary sketch floor plan for this house. Total square footage: 900 sq. feet.

For this house: 7 rooms.

	Square Footage	
Rooms	Minimum	Maximum
1 kitchen	60	125
1 bathroom	40	125
2 bedrooms	100	300
1 living room	220	300
1 dining room	100	300
1 den	250	350

STUDENT ACTIVITY NO. 5

Measure all the rooms in your house with a 3 ft. wooden yard stick and/or your 12 inch plastic ruler.

Sketch and label the floor plan of your house. Write the room sizes. Have instructor check your work.

UNIT TEST

I. Match the terms on the right with the correct definition.

____ 1. The total area of a room or a house obtained by multiplying the length times the width.

____ 2. The art or science of building buildings

____ 3. Drawing freehand, without drafting instruments.

____ 4. A person who designs buildings.

____ 5. How one side of a room or house looks compared to the other side, larger or smaller.

____ 6. A person whose job is to draw pictures and plans of the architects design ideas.

____ 7. The architect's first design ideas for a house which he draws free-hand, without using drafting instruments.

____ 8. Process which makes use of drafting instruments with pencils and sometimes ink to draw the plans for the building contractor to go by in constructing the building.

a. architecture
1
b. architect
c. architectural drafter.
d. architectura drafting.
e. preliminary sketch.
f. proportion
g. sketching
h. square footage

II. The basic rule of design means:

a. form follows function
b. a thing should be shaped according to it's use
c. applies to all manmade objects
d. is used in house design
e. all of the above answers.

III. Name the 6 most common rooms or areas of a house and briefly state where each should be located:

a.
b.
c.
d.
e.
f.
g.

IV. Name two important steps in designing a house.

a.

b.

V. Demonstrate the ability to figure square footage by correctly completing 8 out of 10 of the problems on Student Activity Sheet I.

VI. _____ On an architect's preliminary sketch of a house design:

a. There is no need to consider the placement of windows and doors

b. All doors and windows must be the same size.

c. Doors and windows may be placed wherever they are needed and where there is enough space.

VII. _____ To draw a preliminary sketch floor plan:

a. Start with the bathroom and arrange all other rooms around it.

b. Start with the kitchen and arrange all the other rooms around it.

c. Start by drawing a shape representing the total square footage of the house.

d. Start by putting the bedroom on one side of the house, the kitchen on the other side of the house and all the other rooms in between.

ANSWERS TO UNIT TEST

I. 1. h

2. a

3. g

4. b

5. f

6. c

7. e

8. d

II. e

III. 1. bedrooms--on the quiet side of the house.

2. bathroom--between or near the bedrooms

3. kitchen--easy access to driveway and near dining room.

4. dining area--next to the kitchen.

5. living area--connects with dining area and bedrooms.

6. hallways--minimum necessary to connect other rooms.

IV. 1. Determine the total square footage of the house.

2. Determine the number of rooms needed in the house.

V. See student activity sheet no. 1.

VI. c

VII. c

EQUIPMENT AND SUPPLIES

1. Ordinary #2 pencil with eraser
2. Ordinary tablet or notebook paper
3. A more or less smooth, flat surface to draw on such as a desk top, tablet, notebook or magazine
4. 16th standard ruler
5. A straight edge to draw with, i.e. the ruler, piece of poster board or cardboard
6. Final drawings on handout mimeograph paper.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

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Instructional Section

DRAFTING

Title of unit:

MECHANICAL ENGINEERING

DESCRIPTION OF UNIT

This unit gives a brief discussion and then an overview of mechanical drafting fundamentals. The class will first participate in an equipment making activity (this may be omitted if students have triangles). It will then consider two of the basic ways of drawing an object showing all three sides: orthographic and isometric. It will include the geometric concepts and terms fundamental especially to mechancial drafting.

UNIT OBJECTIVE

At completion of this unit, the student should possess a fundamental knowledge of mechanical engineering and mechanical drafting. Also, after completion of this unit, the student should be able to name and describe the two ways of drawing an object showing three sides, demonstrate his or her knowledge of the terms associated with these two kinds of drawings. The student should be able to demonstrate his or her knowledge of how to make orthographic and isometric drawings by passing the unit test. The student should be able to demonstrate his or her ability to visualize and draw an object orthographically and isometrically.

PERFORMANCE OBJECTIVES

After completion of this unit, the student should be able to:

1. Match the fundamental terms associated with drafting to their definition or description.
2. Identify the kinds of lines used in this unit.
3. Briefly list the steps used in drawing an object orthographically.
4. Briefly list the steps used in drawing an object isometrically.
5. Demonstrate the ability to visualize and draw an object orthographically by making an orthographic drawing of an object pictured isometrically.
6. Demonstrate the ability to visualize and draw an object isometrically by making an isometric drawing of an object pictured orthographically.

OUTLINE OF CONTENT

I. Drafting in Mechanical Engineering

Aside from general idea sketches, there are two main classes of drawings: (1) artistic and (2) technical. The artist expresses philosophic or aesthetic ideas or emotions. When he draws things, he draws them as they appear to him emotionally, and every artist sees things in his own peculiar way. The technical man is concerned with actual objects, and his drawings shown not only how they appear, but how they are. Technical drawing is an exact means of expression, and accuracy is the main objective.

Every new invention or development starts with an idea in the mind of the originator. If he is an engineer, an inventor, or a designer, he will make the drawing himself because he is the only person who can express exactly what he has in mind. Such a person is usually well trained in drafting anyway, and finds it easy to set an idea down in this way. The difficulty is getting the new idea! Usually such an idea develops through several stages, starting probably with a free-hand sketch. This is followed by one or more mechanical drawings, or layouts, drawn accurately with instruments.

Whenever the designer is satisfied with the general scheme, the working drawings are made to be used in the shop. The designer may make these himself or he may turn the work over to the draftsman. In the course of making these working drawings, many details of construction may be worked out, and the draftsman may be required to be somewhat of a designer himself. Salaries of draftsmen depend pretty largely upon how much "head work" or designing they are able to do. The young draftsman is in a very favorable position to learn all about the products of the company and to advance rapidly to key positions if his ability warrants it.

A working drawing is a complete drawing or set of drawings such that the object represented can be built from it alone without additional information. Such a drawing is a description of the object and is composed of two parts, the views and the dimensions.

Just as in the written language, the graphic language has its' grammer and its symbols. The alphabet of lines and the rules of presentation are examples of this.

By means of views, the mechanic can visualize the object to be built; if the drawing is right, he will visualize exactly what the designer has in mind. This ability to visualize or "think in three dimensions" is essential to the designer, the draftsman, the mechanic, and all other people in technical work. It is one of the principal values to be derived from the study of industrial drafting. It is also one of the best means of developing the "constructive imagination" so essential in all original designing.

By means of dimensions, the mechanic can tell exactly what size each part is to be. This applies not only to large dimensions or rough measurements, but in many cases to extremely accurate measurements often down to a ten-thousandth of an inch or less.

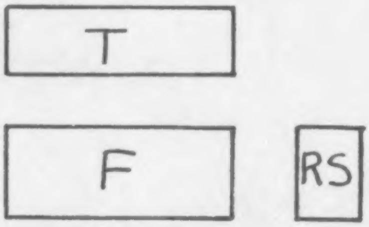
Thus, the working drawing gives a complete story and industrial prints made from it can be mailed to factories in any part of the country or the world. Also, all the separate parts can be made exactly as planned and then shipped to a central assembly plant where they will fit into the assembly as intended.

CONTENT (CONTINUED)

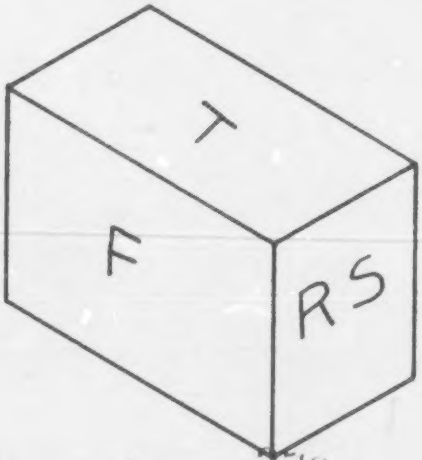
II. Two ways of showing three sides of an object in one drawing: orthographic and isometric. Show transparencies

Any rectangular object has six sides: top, bottom, front, back, left and right sides. (Demonstration of six sides must be done with a real object. Teacher should hold a rectangular object and point at top, bottom, front, back, left and right sides). Anything on the bottom of the object can be shown on the top view. Anything on the left side of the object can be shown on the right side view. Therefore, a rectangular object can be fully described using three views: front, top and right side.

A. Orthographic drawings show these three sides separated like this:



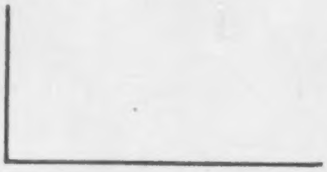
B. Isometric drawings show these three sides connected like this:



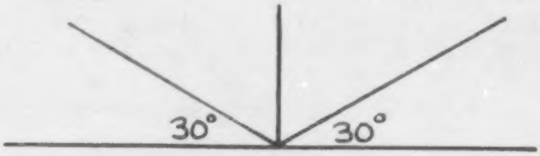
1. A whole circle has 360°.

2. Half a circle has 180°. (This is a straight line through a circle).

3. One fourth of a circle has 90°. Lines used to divide a circle into four parts make a 90° or right angle which is used as the starting position for orthographic drawings:



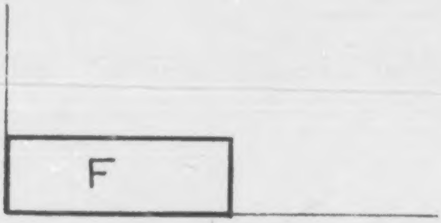
4. One third of 90° part of a circle is 30°. Lines used to show 30° part of a circle make a 30° angle. Two 30° angles, one to the left and one to the right of center, are used as the starting position for isometric drawings; and can be drawn using your 30°/60° triangle.



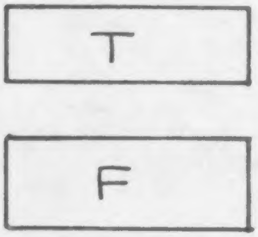
III. Starting position and steps used to draw an orthographic drawing.

A. For starting position, lightly sketch a right angle.

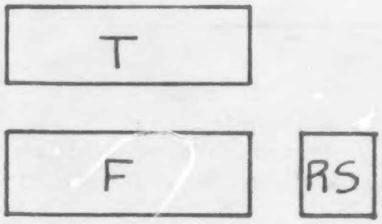
B. Draw and label front view in corner of right angle:



C. Draw and label top view directly above front view.



D. Draw and label right side view directly to right of front view.

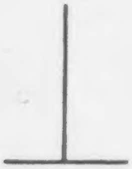


(NOTE: Top view must be directly above front view and right side view must be directly to the right of front view. Always label front view F, top view T, and right side view R.S.).

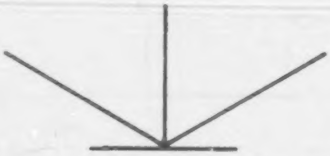
IV. Starting position and steps used to draw an isometric drawing.

A. Draw a short base line:

B. Draw a light vertical line (any length) on baseline:

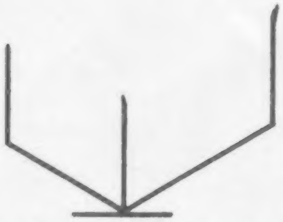


C. Using a 30°/60° triangle, draw 30° angle lines to right and left of vertical line.

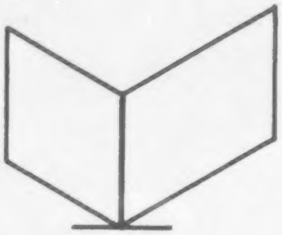


(This is a starting position.)

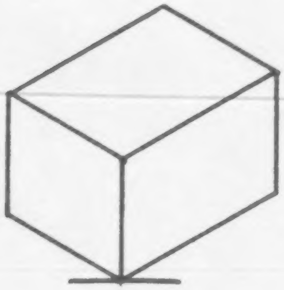
D. Draw vertical lines (any length) on both sides:



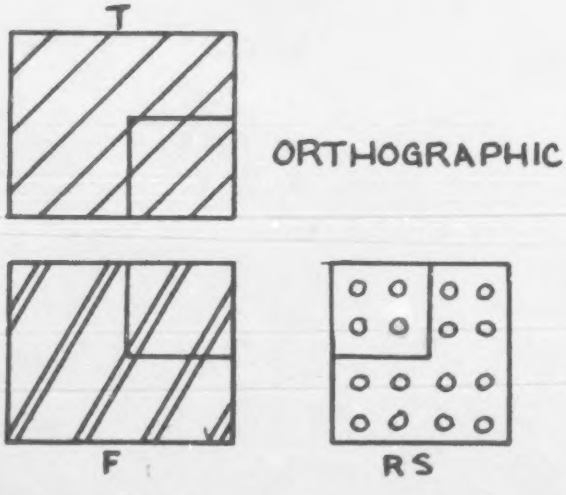
E. Draw top 30° angle lines right and left parallel to bottom 30° angle lines right and left:

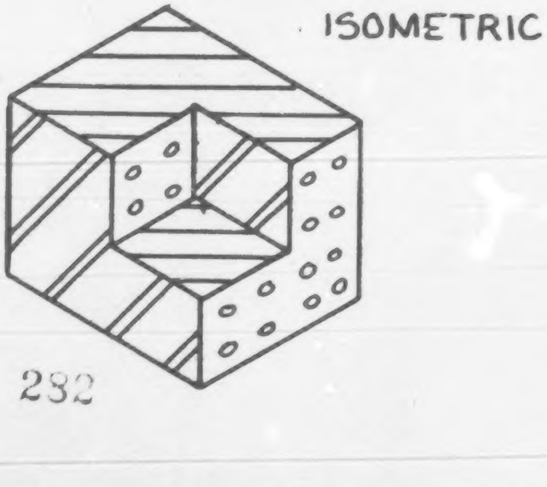


F. Complete top with two more 30° angle lines parallel to other 30° angle lines:



V. Demonstration of depth perception using a cataway block with lines, texture of colors to illustrate front, top and right side views.





TEACHER ACTIVITIES

1. Make transparencies, if not provided.
2. Provide students with objective sheet.
3. Provide students with information and assignment sheets.
4. Discuss unit and specific objectives.
5. Discuss information and assignment sheets.
6. Teach the students by lecture, demonstration, and individual assistance how to do the assignment.
7. Give tests.

STUDENT ACTIVITIES

1. Read objective sheet.
2. Study information sheet.
3. Complete assignment sheets.
4. Take tests.

REFERENCES/RESOURCES

II. References

A. Ross, Stan, The World of Drafting, Bloomington, Illinois: McKnight & McKnight Publishing Company, 1971.

B. Spencer, H. D., Basic Technical Drawing, New York: McMillan Company, 1956.

I. Resources

A. Suggested Procedure

2. Information Sheet

3. Transparency Masters

4. Assignment Sheets

SUGGESTED PROCEDURE

I. Class will participate in making 30°/60° triangles out of poster board (see transparencies no.'s 2.16 and 2.17). Have students do student activity No. 1. This procedure may be omitted if students possess triangles, if so proceed to step No. II.

II. Give overview of the entire unit.
Read and explain the performance objectives.
Look at an explain information sheets and assignment sheets.
Explain:
    I. Terms and definitions
    II. Two ways of showing three sides of an object in one drawing:
        A. Orthographic drawings
        B. Isometric drawings
Have students do student activity No. 2

III. Briefly review step No. II.
Explain and demonstrate on chalkboard steps used to draw an orthographic drawing.
Explain and demonstrate on chalkboard steps used to draw isometric drawings.
Have students do student activities No. 3 and No. 4.

IV. Briefly review and answer questions from step No. III.
Have students do student activity No. 5.
Explain and demonstrate on chalkboard depth perception illustrated with cutaway block.
Have students do student activity No. 6.

V. Review and answer any questions from steps No.'s I, II and III.
Have students do student activities No. 7 and No. 8 if possible.

VI. Have students do student activity No. 9

VII. Have students do student activity No. 10.

VIII. Have students take the unit test.
Have students complete and turn in all drawings.

INFORMATION SHEET NO. 1

I. Drafting in Mechanical Engineering

Aside from general idea sketches, there are two main classes of drawings: (1) artistic and (2) technical. The artist expresses philosophic or aesthetic ideas or emotions. When he draws things, he draws them as they appear to him emotionally, and every artist sees things in his own peculiar way. The technical man is concerned with actual objects, and his drawings shown not only how they appear, but how they are. Technical drawing is an exact means of expression, and accuracy is the main objective.

Every new invention or development starts with an idea in the mind of the originator. If he is an engineer, an inventor, or a designer, he will make the drawing himself because he is the only person who can express exactly what he has in mind. Such a person is usually well trained in drafting anyway, and finds it easy to set an idea down in this way. The difficulty is getting the new idea! Usually such an idea develops through several stages, starting probably with a free-hand sketch. This is followed by one or more mechanical drawings, or layouts, drawn accurately with instruments.

Whenever the designer is satisfied with the general scheme, the working drawings are made to be used in the shop. The designer may make these himself or he may turn the work over to the draftsman. In the course of making these working drawings, many details of construction may be worked out, and the draftsman may be required to be somewhat of a designer himself. Salaries of draftsmen depend pretty largely upon how much "head work" or designing they are able to do. The young draftsman is in a very favorable position to learn all about the products of the company and to advance rapidly to key positions if his ability warrants it.

A working drawing is a complete drawing or set of drawings such that the object represented can be built from it alone without additional information. Such a drawing is a description of the object and is composed of two parts, the views and the dimensions.

Justas in the written language, the graphic language has its grammer and its symbols. The alphabet of lines and the rules of presentation are examples of this.

By means of views, the mechanic can visualize the object to be built; if the drawing is right, he will visualize exactly what the designer has in mind. This ability to visualize or "think in three dimensions" is essential to the designer, the draftsman, the mechanic, and all other people in technical work. It is one of the principal values to be derived from the study of industrial drafting. It is also one of the best means of developing the "constructive imagination" so essential in all original designing.

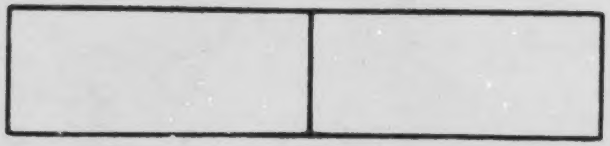
By means of dimensions, the mechanic can tell exactly what size each part is to be. This applies not only to large dimensions or rough measurements, but in many cases to extremely accurate measurements often down to a ten-thousandth of an inch or less.

Thus, the working drawing gives a complete story and industrial prints made from it can be mailed to factories in any part of the country of the world. Also, all the separate parts can be made exactly as planned and then shipped to a central assembly plant where they will fit into the assembly as intended.

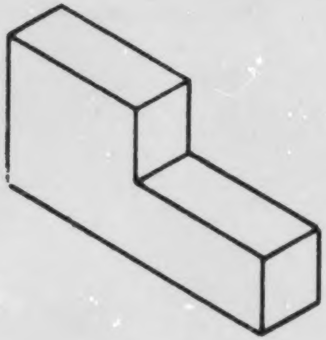
INFORMATION SHEET NO. 2

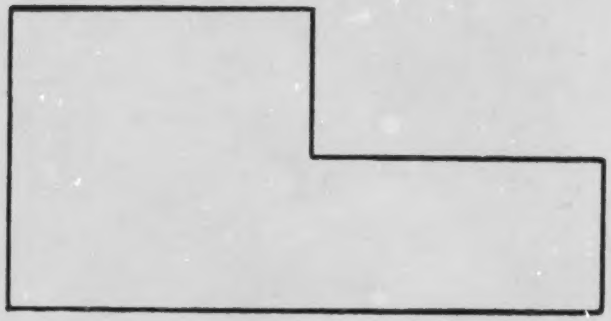
TERMS AND DEFINITIONS

1. Angle--Two straight lines that meet at one end. The size of the angle is determined by what part of a circle the angle occupies.
2. Degrees--The measurement of an angle according to what part of a circle it occupies. 360° in a circle.
3. Horizontal--A line straight across and parallel to the horizon.
4. Hidden object line--A line of small dashes used to show detail that you cannot see from your point of view.
5. Isometric view--A drawing that shows all three sides of an object with the three sides connecting.
6. Orthographic views--A drawing that shows three sides of an object separated into front view, top view, and right side view.
7. Parallel--Lines that are the same distance apart the whole length of the lines.
8. Vertical--Straight up and down.
9. View--What you can see from the direction you are looking at an object.
10. Front view--What you can see looking straight on the front side of an object.
11. Top view--what you can see looking straight down on the top of an object.
12. Right side view--What you can see looking straight on the right side of an object.
13. Visible line--A solid line used to outline and draw visible surface detail on it.

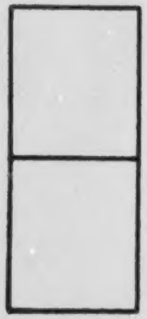


TOP VIEW

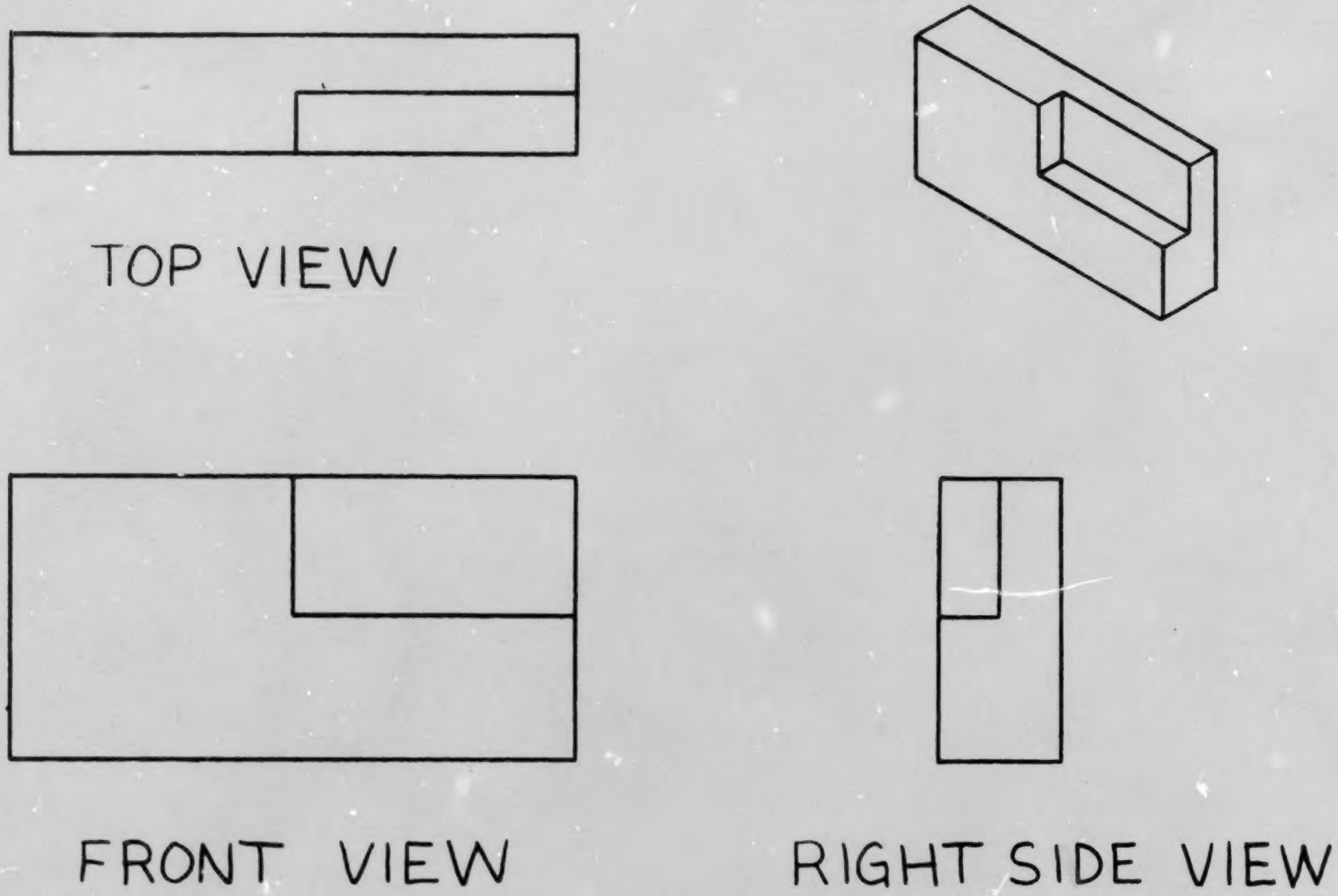


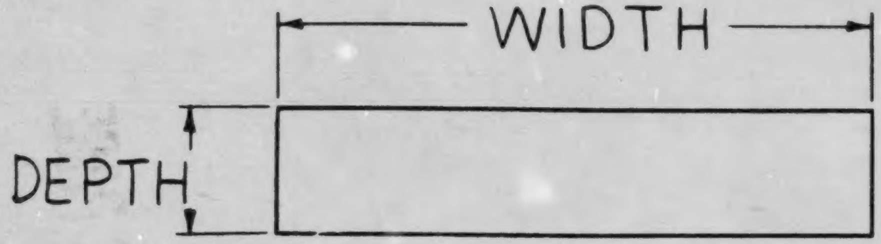


FRONT VIEW

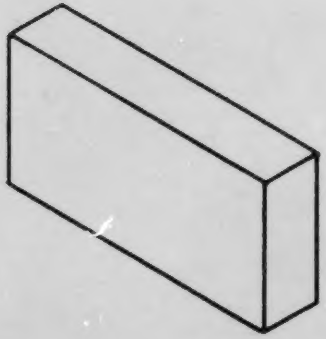


RIGHT SIDE VIEW

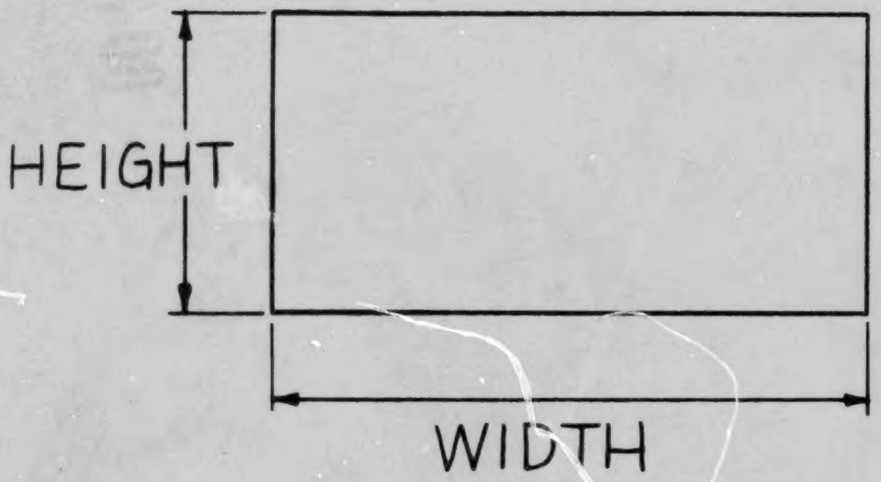

TOP VIEW
FRONT VIEW
RIGHT SIDE VIEW


WIDTH
DEPTH

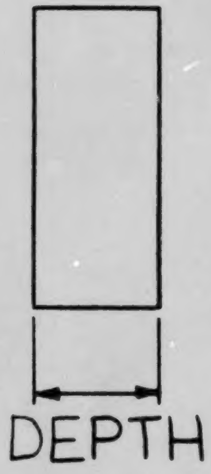
TOP VIEW



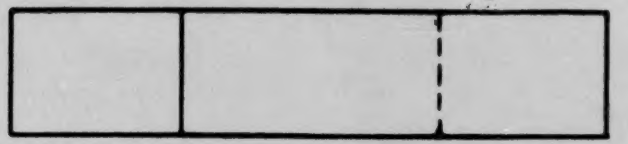
ISOMETRIC VIEW

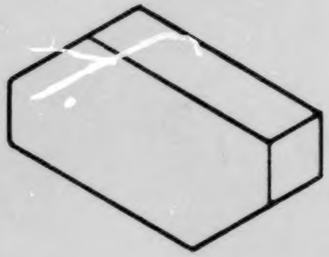

HEIGHT
WIDTH

FRONT VIEW

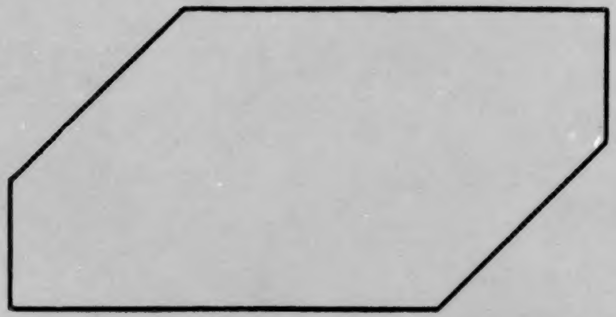


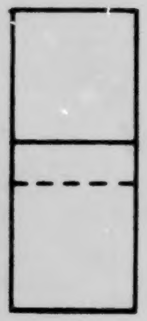
RIGHT SIDE VIEW



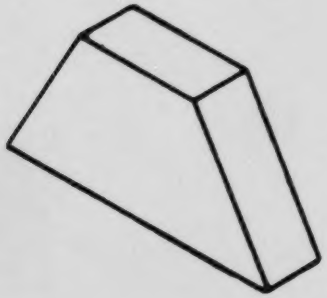


ISOMETRIC VIEW





ORTHOGRAPHIC VIEWS



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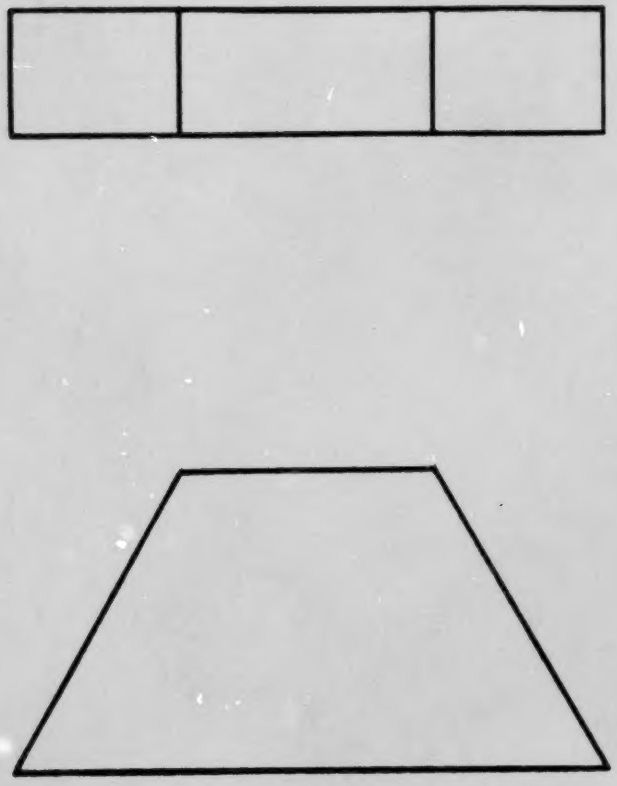

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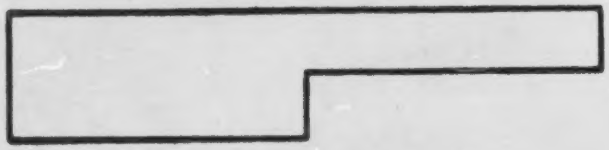
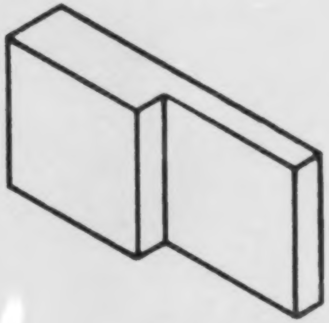
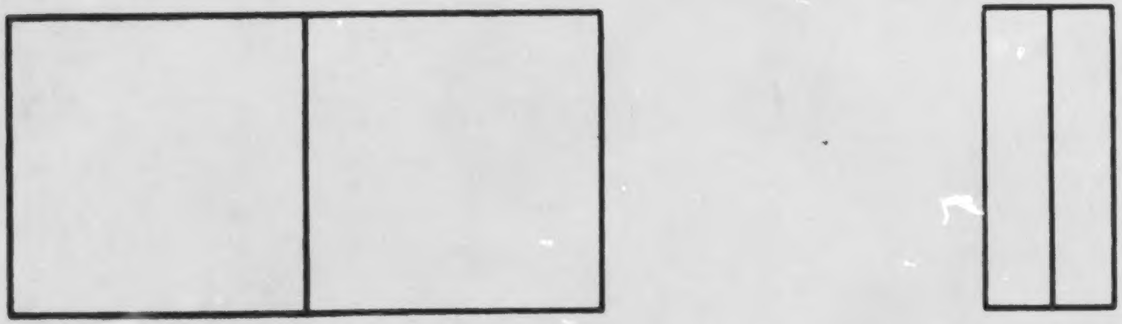
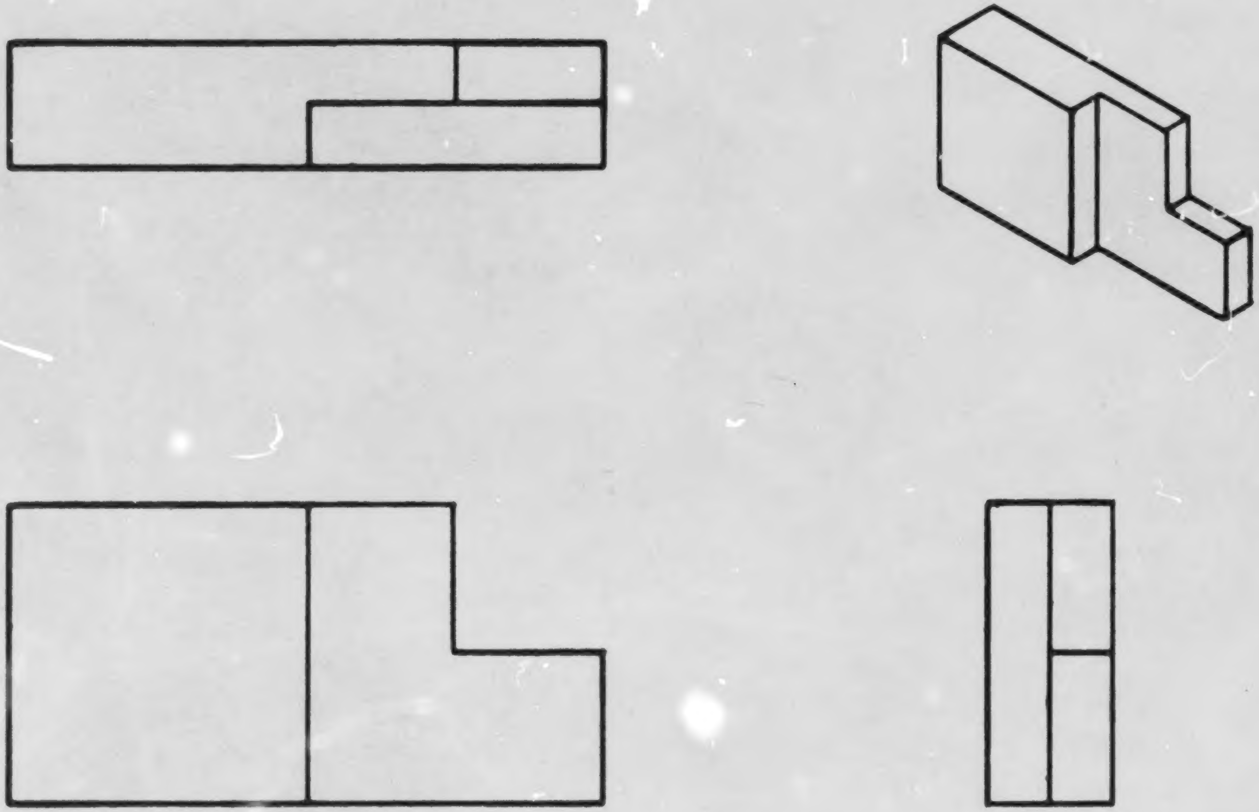




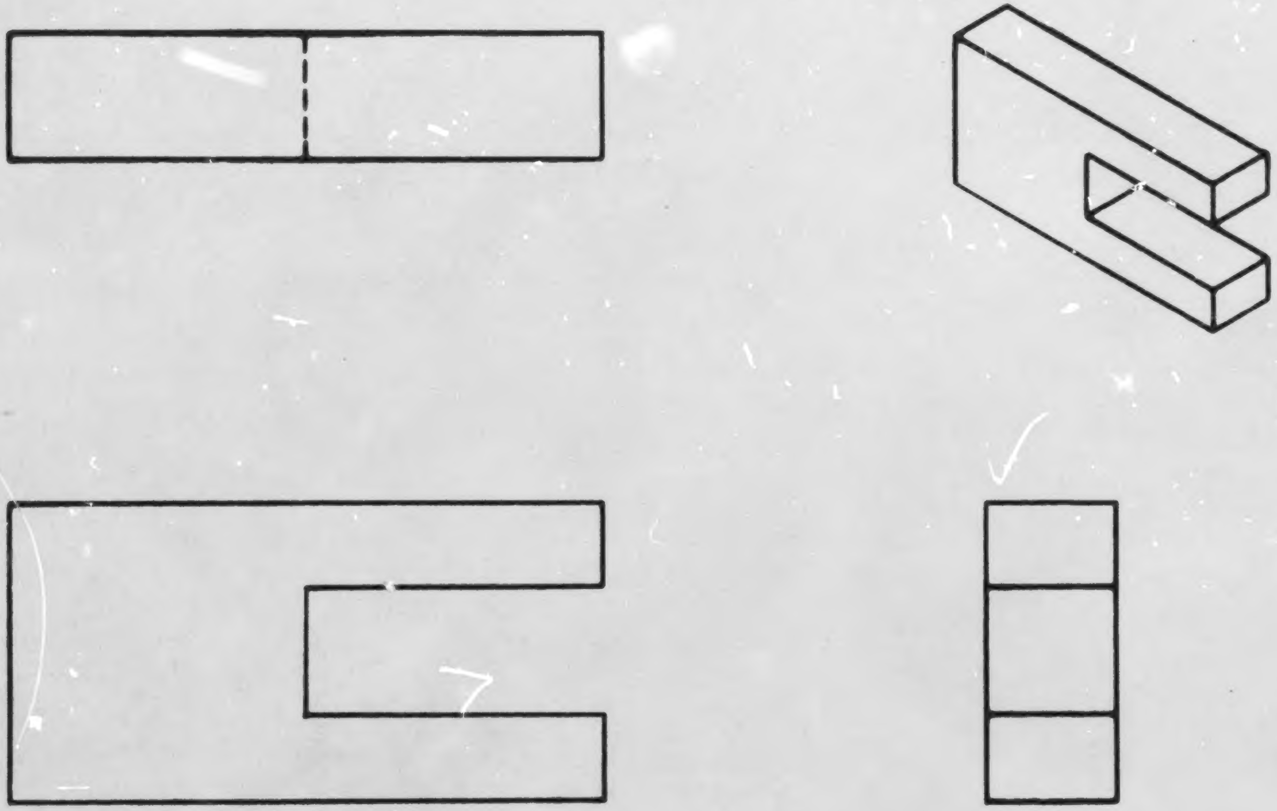
ISOMETRIC VIEW

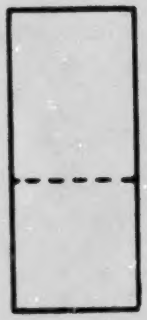


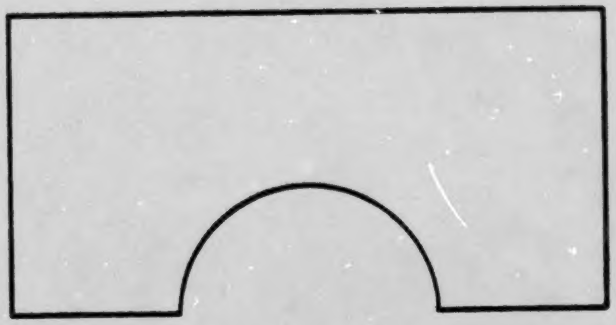
ORTHOGRAPHIC VIEWS

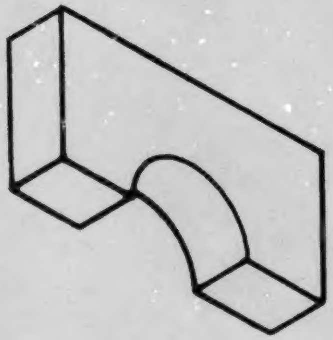


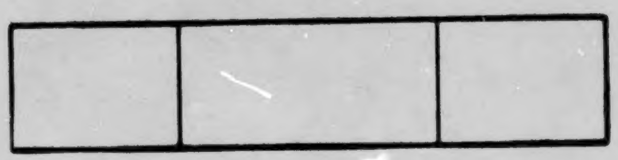
T.M.-7 / DD 2.14-G

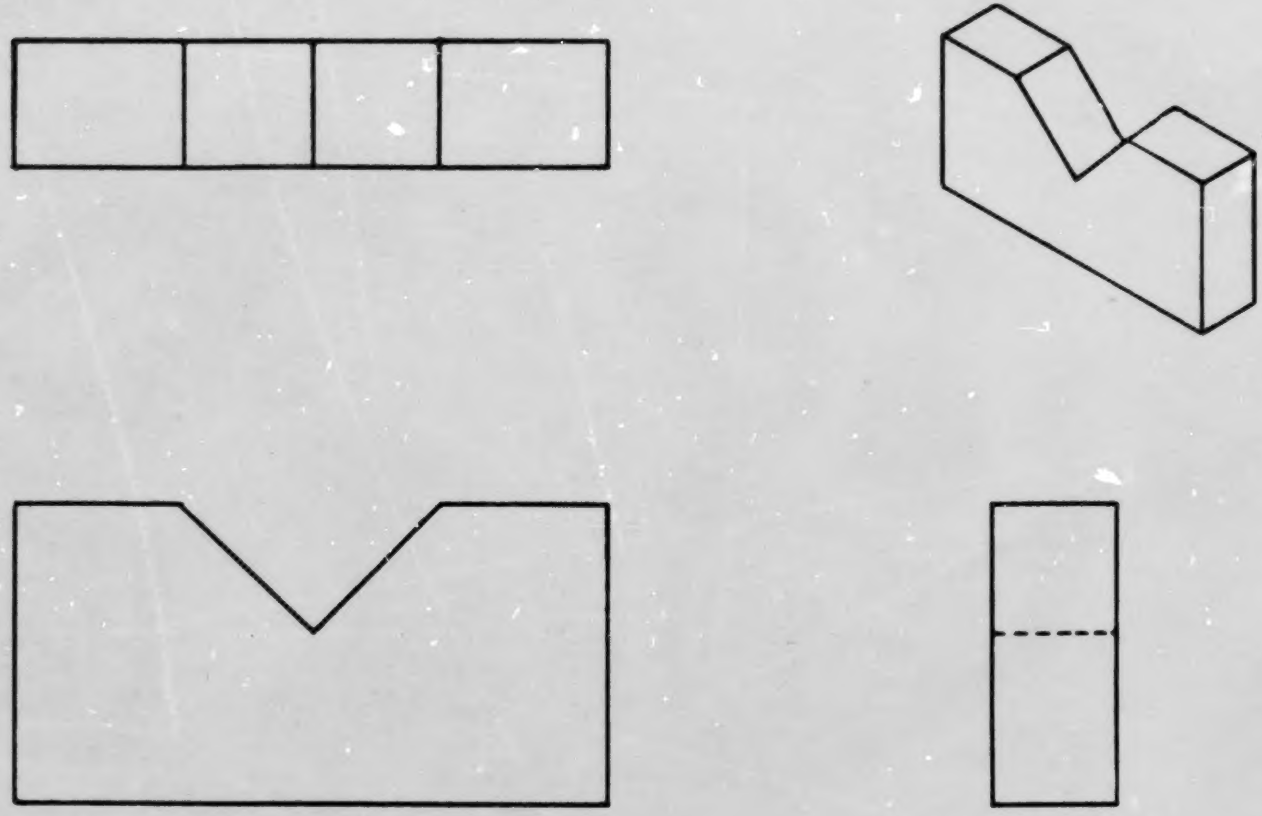












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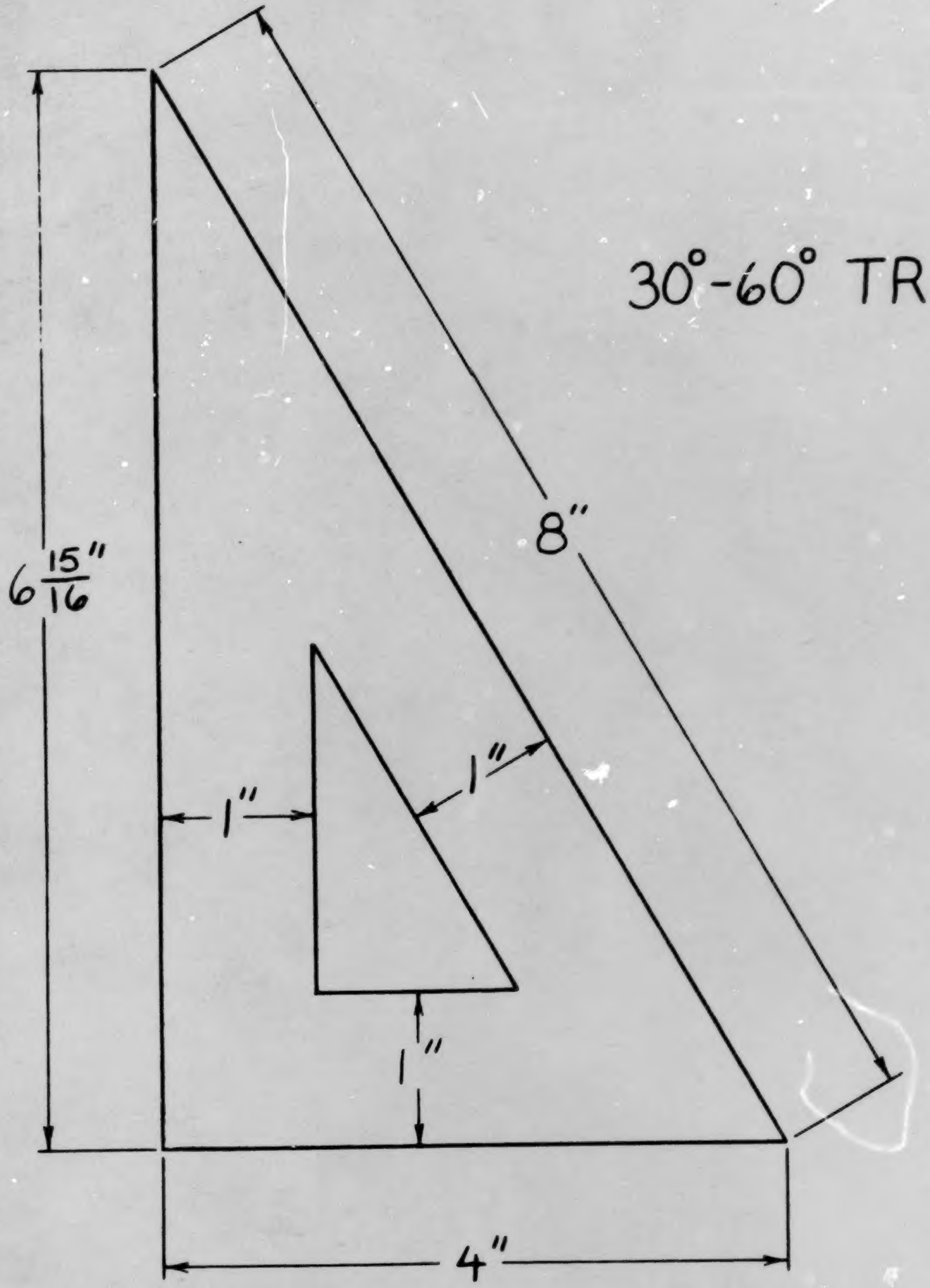
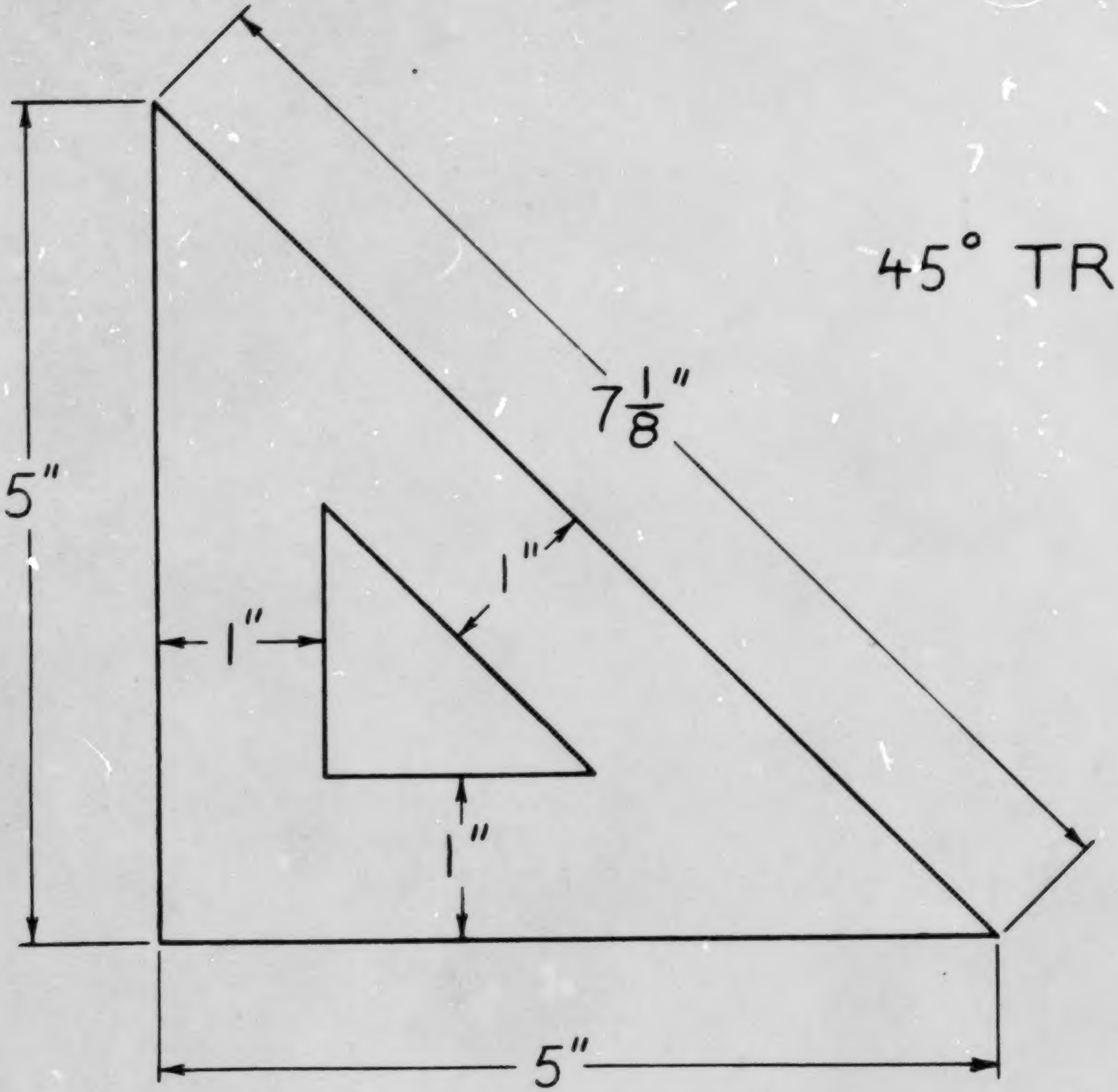

6 15/16"
8"
1"
1"
1"
4"

30°-60° TRIANGLE



45° TRIANGLE

311

312

T.M.-12 / DD 2.14-L

STUDENT ACTIVITY NO. 1

(On poster board or card board)

A. MAKING THE 30°/60° TRIANGLE

Draw a horizontal line near bottom of paper 4" long draw a vertical line connecting to the left side of the horizontal line 6 15/16" long.

The diagonal line should be 8" long. Now cut out figure.

B. MAKING A 45° TRIANGLE

Make a horizontal line near bottom of paper 5" long. Make a vertical line 5" long connecting to the left side of the horizontal line. Now draw a line connecting the ends making a 45° triangle.

This line should be 7 1/8" long. Now cut out figure.

C. Make a straight edge 3" wide by 2' long.

STUDENT ACTIVITY NO. 2

On your own paper:

Copy step by step the drawing part on the Outline of Content. Part II. (Starting position and steps used to draw an orthographic drawing)

STUDENT ACTIVITY NO. 3

On your own paper:

Step by step, copy the drawing on the Outline of Content. Part III. (Starting position and steps used to draw an isometric drawing)

DD 2.18

STUDENT ACTIVITY NO. 4

Following the steps on the Outline of Content, Parts II and III, copy on your own paper, the following rectangle:

Following the steps on the Outline of Content, Parts II and III, copy on your own paper, the same rectangle in a different position:

STUDENT ACTIVITY NO. 5

On your own paper, copy the orthographic and isometric drawings of the cutaway block. Add dots to the front view surfaces, lines to the top view surfaces and little dots to the right side view surfaces.

STUDENT ACTIVITY NO. 6

On your own paper, following the steps on the Outline of Content, part II, (Steps used in orthographic drawing), copy these orthographic drawings.

STUDENT ACTIVITY NO. 7

On your own paper, following the steps on the Outline of Content, part II, (Steps used in isometric drawing), copy these drawings:

STUDENT ACTIVITY NO. 8

On a piece of paper, make orthographic drawings of the isometric drawings on Student Activity Sheet No. 7. When you have finished, compare your drawings with those on Student Activity Sheet No. 6.

STUDENT ACTIVITY NO. 9

On a piece of paper, make isometric drawings of the orthographic drawings on Student Activity Sheet No. 6. When you have finished, compare your drawings with those on Student Activity Sheet No. 7.

STUDENT ACTIVITY NO. 10

Take floor sketch of home from unit No. 1 and do scale drawing of floor plan on poster board 18" x 24"; scale 1" = 4'.

STUDENT ACTIVITY NO. 11

Measure outside walls. Layout on poster board. Cut out.

UNIT TEST

I. Match the terms on the right with their correct definitions:

_____1. A drawing that shows 3 sides of an object separated into front view, top view, and side view.

_____2. A solid line used to outline an object and draw visible surface detail.

_____3. Two straight lines that meet at one end.

_____4. What you can see from the direction you are looking at an object.

_____5. A drawing that shows 3 sides of an object with 3 sides connected.

_____6. Straight up and down.

_____7. A line of small dashes used to show detail that you cannot see.

_____8. The measurement of an angle according to what part of a circle it occupies.

_____9. Lines that are the same distance apart the whole length of the lines.

_____10. A line straight across and parallel to the horizon.

A. Angle
B. Degrees
C. Horizontal
D. Hidden object line.
E. Isometric view
F. Orthographic
G. Parallel
H. Vertical
I. View
J. Visible line

II. _____A. Orthographic drawings show:

a. three sides connected
b. three sides separated
c. any of the six sides of an object.

_____B. Isometric drawings show:

a. three sides connected
b. three sides separated
c. any of the six sides of an object.

_____C. One fourth of a circle has:

a. 360°
b. 180°
c. 90°
d. 45°
e. 30°

_____D. A whole circle has:

a. 360°
b. 180°
c. 90°
d. 45°
e. 30°

_____E. One third part of 90° part of a circle is:

a. 360°
b. 180°
c. 90°
d. 45°
e. 30°

_____F. One half a circle has:

a. 360°
b. 180°
c. 90°
d. 45°
e. 30°

III. Name the four steps used in orthographic drawings. (Answer with words or sketch.)

IV. Name the six steps used in isometric drawings. (Answer with words or sketch.)

UNIT TEST ANSWERS

I. 1. F.

2. J.

3. A.

4. I

5. E

6. H

7. D

8. B

9. G

10. C

II. A. b

B. a

C. c

D. a

E. d

F. b

III. 1. Starting position a right angle.

2. Front view in corner of right angle.

3. Top view directly above front view.

4. Ride side view to right side of front view.

UNIT TEST ANSWERS (continued)

IV. 1. A short base line.

2. A vertical line on baseline.

3. Right and left 30° angle line.

4. Vertical lines on 30° angle lines.

5. Top 30° angle lines parallel to bottom 30° angle lines.

6. Complete top with two more paraellel 30° angle lines.

EQUIPMENT/SUPPLIES

1. Ordinary No. 2 pencil with eraser.
2. Ordinary tablet or notebook paper.
3. A more or less smooth, flat surface to draw on, such as a desk top, tablet, notebook, or magazine.
4. A straight edge to draw with, i.e. a ruler, piece of poster board or cardboard.
5. Final drawings on handout mimeograph paper.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instruction Section:

DRAFTING AND DESIGN

Title of Unit:

INDUSTRIAL ENGINEERING

DESCRIPTION OF UNIT

This unit will cover the technique of free hand lettering using the single-stroke gothic alphabet and numbers. Free hand lettering is very much in use in the industry and therefore, this unit may be regarded as exploratory of ths field.

UNIT OBJECTIVE

After completion of this unit, the student should be able to do free hand lettering, upper case, using vertical, single-stroke Gothic alphabet and numbers. The student should be able to space letters together into words and words into sentences legibly. The student should be able to demonstrate this knowledge by making a lettering plate and by scoring 70 or better on the unit test.

PERFORMANCE OBJECTIVES

After completion of this unit, the student should be able to:

1. Match lettering terms to the correct definition or description.
2. Identify vertical single-stroke Gothic alphabet and numbers, upper case. (Information Sheet)
3. Identify guidelines associated with lettering.
4. Demonstrate the ability to make vertical single-stroke Gothic alphabet and numbers, upper case; avoiding the common mistakes. (Do Student Activity Sheet #1)
5. Demonstrate the ability to draw fractions alone and in relation to whole numbers. (Do Student Activity Sheet #3).

6. Briefly list the rules for spacing letters in words.

7. Briefly list the rule for spacing words in sentences legibly.

8. Demonstrate the ability to do all the above by making a lettering plate using vertical, single-stroke Gothic alphabet and numbers separately and in sentences.

9. Demonstrate knowledge of all the above by scoring 70 or above on the unit test.

OUTLINE OF CONTENT

I. Introduction to Lettering

II. Terms and Definitions

III. Vertical, single-stroke Gothic alphabet and numbers, upper case; and common mistakes of beginners and how to avoid them.

IV. Guidelines and terms associated with lettering.

V. Rules for making fractions in relations to whole numbers.

VI. Rules for spacing letters in words.

VII. Rule for spacing words in sentences.

TEACHER ACTIVITIES

1. Make transparencies.
2. Provide students with objective sheet.
3. Provide students with information, assignment sheets.
4. Discuss unit and performance objectives.
5. discuss information and assignment sheets.
6. Show students examples of good lettering plates.
7. Teach the student by lecture, demonstration and individual assistance how to do the assignments.
8. Give tests.

STUDENT ACTIVITIES

1. Read objective test.
2. Study information sheets.
3. Take tests.
4. Complete assignment sheets.

REFERENCES/RESOURCES

I. References

A. French, Thomas E. and Carl L. Svensen, Mechanical Drawing. St. Louis, Missouri; Webster Division, McGraw-Hill Book Company, 1957.

B. Spencer, Henry Cecil and John Thomas Dygdon. Basic Technical Drawing. New York: The MacMillan Company, 1968.

II. Resources

1. Objective sheet
2. Information sheets
3. Transparency masters
4. Assignment sheets

SUGGESTED PROCEDURE

I. Give overview of the entire unit.
Read and explain the Performance Objectives.
Look at and explain the information sheets and assignment sheets.
Explain:
  I. Terms and definitions, using examples on other information sheets for illustration.

  II. Vertical, single-stroke Gothic alphabet and numbers upper case; show transparencies; and demonstrate on chalkboard how to form each letter. Point out common mistakes and how to avoid them.

II. Briefly review and answer question from Step No. I. Have students do Activity Sheet #1.

III. Explain Information Sheet #4
Have students do Activity Sheet #2
If this does not take the whole period, you may give the second page of the unit test as a test.

IV. Explain Information Sheet #5 (rules for spacing letters in words) and (rule for spacing words in sentences).
Demonstrate on the chalkboard how this is done.
Have students to Student Activity Sheet #3.

V. Have student make a lettering plate on drafting paper.

VI. Give Unit Test and finish any unfinished lettering plates.

INFORMATION SHEET NO. 1

INTRODUCTION TO LETTERING

You have dealt with orthographic and isometric drawings in a previous section. You will now see some more complex industrial objectis drawn orthographically and isometrically (show transparency numbers 3.18, 3.19, 3.20, 3.21, 3.22, 3.23, 3.24, 3.25, 3.26, 3.27 inclusive).

As you can see something has been added to these drawings, it is the dimensions and notes without which no drawing is complete. These dimensions and notes require an understanding of lettering, and the remainder of this section will be dedicated to your acquiring a basic lettering ability. Children "print", draftsmen letter.

The letters of our alphabet are symbols for sounds. When letters are placed in combinations, words result which have meanings. All writing or lettering started in some form of pictograph (picture writing), but it took prehistoric man thousands of years to develop letters first from the earliest cave drawings, then from pictographs. Among the earliest forms of pictographs were the ancient Egyptian hieroglyphics (pronounced high-a-row-glif'iks).

The story of the alphabet is an interesting subject which would require a book in itself. It is enough for our purposes to know that the early Phoenicians developed an alphabet of twenty-two characters from earlier picture writing and that these were later developed by the Greeks and then the Romans. As a result of Roman conquests the Latin alphabet was adopted throughout most of the then civilized world. The Old Roman alphabet, is the direct parent of all our present letter forms.

Early industrial drawings were lettered with what we would regard as "fancy" letters conforming to the historical styles, usually Roman. In those days, it was the fashion for houses, furniture, and other manufactured products to be over-decorated with meaningless "curlicues". As industry advanced, everything became more streamlined or functional, and fancy lettering frills were abandoned. About fifty years ago, C. W. Reinhardt developed alphabets based upon the Gothic letters which could be easily made with single strokes of an ordinary pencil or pen. These were called single-stroke Gothic letters, and are very similar to our present letters.

In 1935, the letters were further standardized when the American Standards Association adopted standard alphabets of vertical and inclined letters, and with slight revision in 1936 and again in 1956, have become accepted generally as the "last word" for use in industrial drafting.

INFORMATION SHEET NO. 2

TERMS AND DEFINITIONS

1. Base line--The main guideline for lettering from which the upper and lower guidelines are spaced.

2. Bleeding--The rulling together of lines on a print caused by lines on the original drawing touching or being too close together.

3. Cap line--The top guideline which the capital letters must reach.

4. Capital letters--The big letter; upper case.

5. Drop line--The lowest guideline which the descenders must reach.

6. Fraction--Refers to two numbers, one above the other with a bar between which represents part of a unit or whole number.

7. Gothic--Refers to the lettering style that has no serifs.

8. Guidelines--Extremely light lines between which you put lettering.

9. Legible--Easy to read.

10. Roman alphabet--The alphabet that has serifs.

11. Serifs--Those little marks on the ends of lines in the Roman alphabet.

12. Single stroke--Means the lines the letters are made with are the width of one stroke of the pencil or pen.

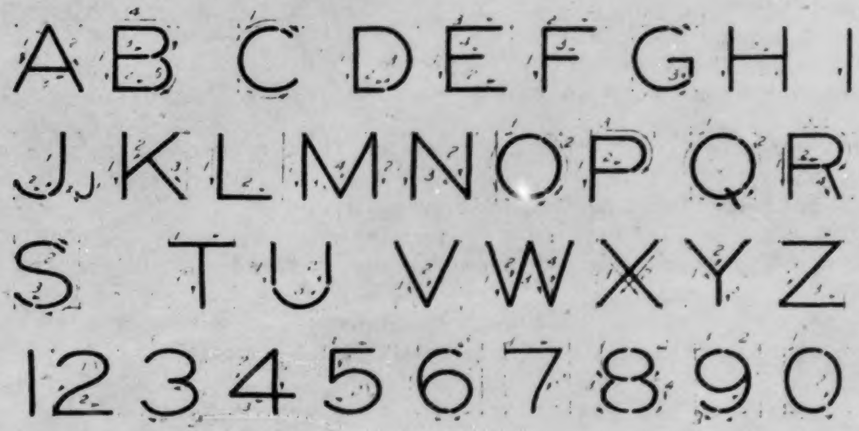
13. Upper case letters--The big letters, the capitals in an alphabet.

14. Vertical--Straight up and down.

15. Whole number--Consists of one or more units; not a fraction.

INFORMATION SHEET NO. 3

Vertical, Single-Stroke Gothic Alphabet and Numbers
Upper Case



Common Mistakes of Beginners and How to Avoid Them

1. Putting serifs on capital I, G, J, U and numbers 1, 7, (Not I, G, J, U, 1 and 7.)
2. Making sides of M and N slanted instead of vertical. Avoid this by making the two vertical sides first and then putting in slanted middle lines.
3. Making K and R that look "peg-legged" instead of like a KICKER. Avoid this mistake by associating K and R with the word kicker; the downware stroke must go outward like a leg kicking.
4. The tops of 6, 5, 3, and 8 that are not smaller than their bottoms. Avoid this by practicing making the toop part slightly smaller than the bottom part.
5. Round letters that are not full and round. Practice making these letters full and round:

   C, D, G, O, Q & 6, 8, 9, 0

6. Letters that touch each other. Letters must not touch each other for two reasons. Words are more legible when the letters stand apart. All drafting is to be reproduced. Contractors and manufacturers do not work from original drawings. Lines that touch or are almost touching will cause those lines to "bleed" and run together on the print.

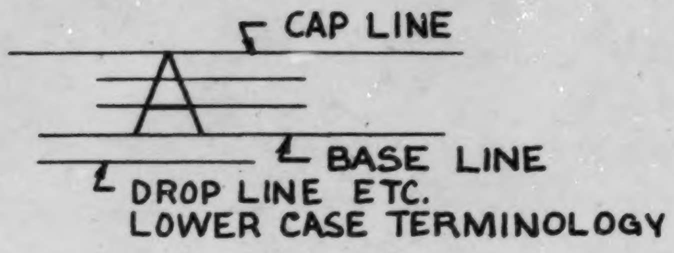
7. W is double V ;not upside down M .

8. Letters and numbers leaning to the right when they are supposed to be vertical.

DD 3.12

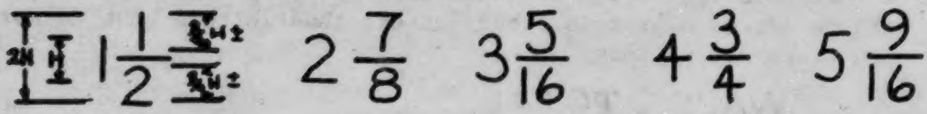
INFORMATION SHEET NO. 4

Guidelines and Terms Associated with Lettering.


CAP LINE
BASE LINE
DROP LINE ETC.
LOWER CASE TERMINOLOGY

INFORMATION SHEET NO. 5

Rules for Maing Fractions in Relation to Whole Numbers



1. Total height of fraction is twice the height of the whole number but:
2. Numbers in fraction are smaller than whole numbers to allow for bar and space between the bar and the fraction numbers.
3. None of these lines may touch each other or anything else. They must stand apart.

DD 3.14

INFORMATION SHEET NO. 6

Rules for Spacing Letters in Words

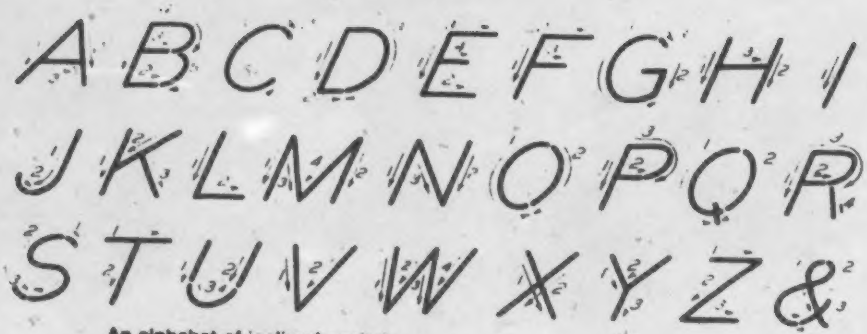
1. Do not put letter together in words as if all letters occupy the same amount of space. They don't.

2. Letters that have open space around them, (C, E, F, J, L, P, T, V, W, & Y) should be spaced closer to other letters than letters that do not have open space around them,
Example:
WAVE , TOTAL

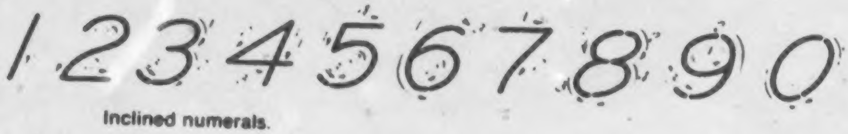
3. Letters with straight sides and closed sides (B, D, G, H, I, S, & U), (The left side of K, L, P & R) need a little more space between them and other letters.
Example:
HIRED

Rules for Spacing Words in Sentences

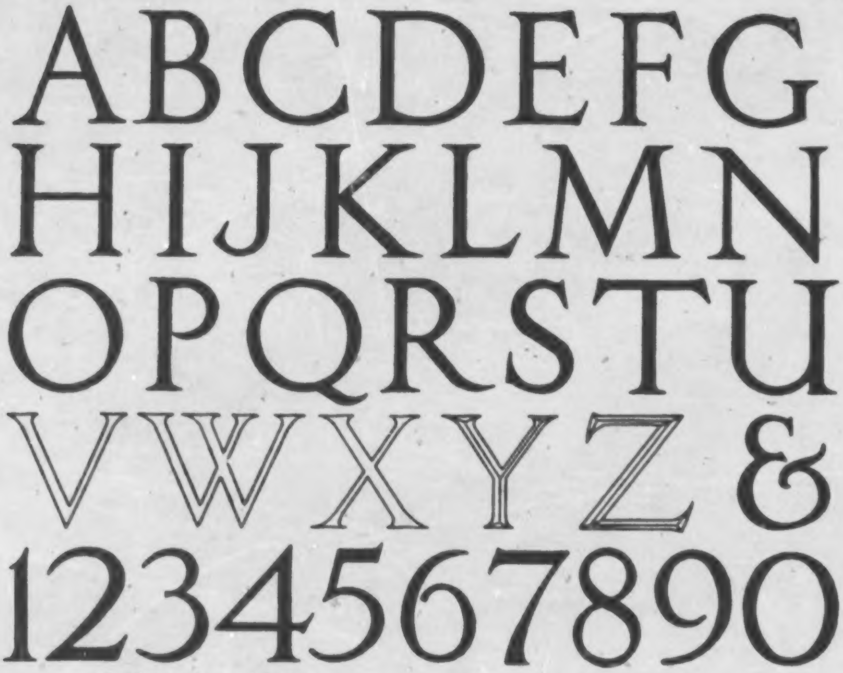
Beginners tend to run words together in sentences. Therefore, the rule for spacing words in sentences is simply leave more space between words in sentences, at least as much as 2 letters.


ABCDEFGHI
JKLMNOPQR
STUVWXYZ&

An alphabet of inclined capitals.

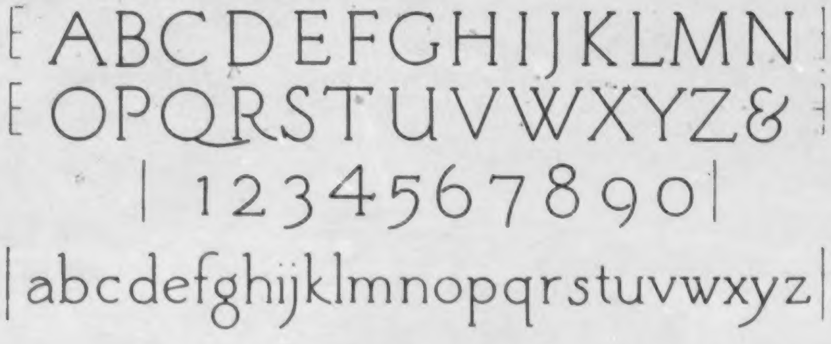

1234567890

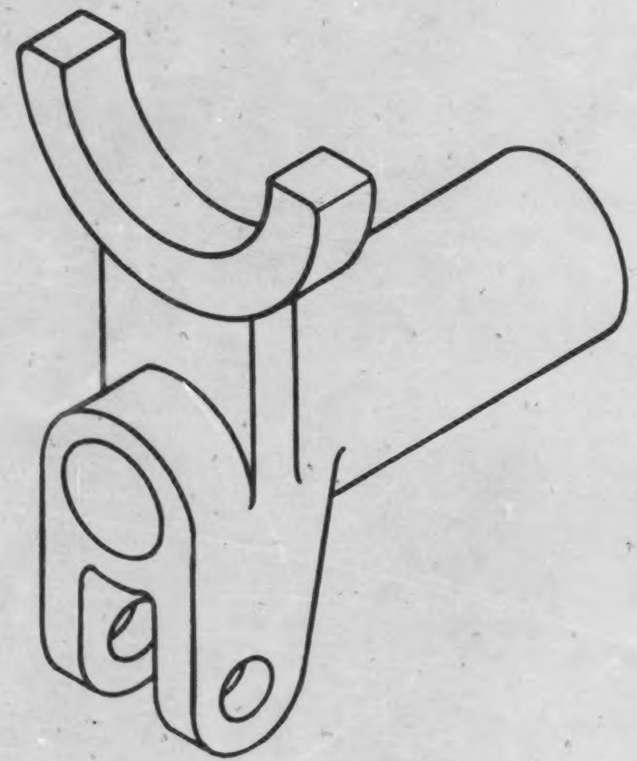
Inclined numerals.


ABCDEFG
HIJKLMN
OPQRSTU
VWXYZ&
1234567890

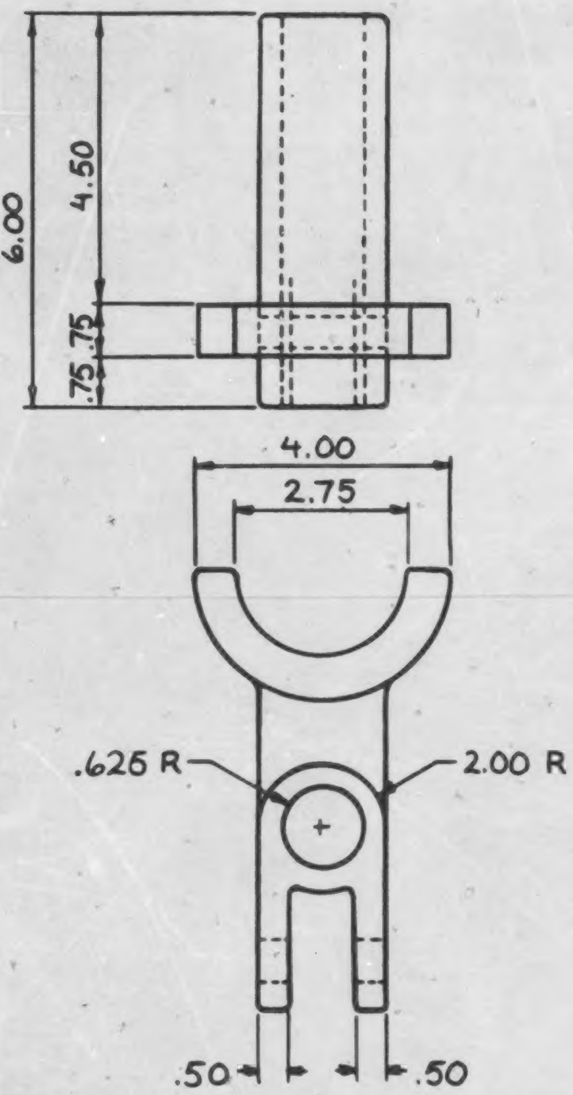
An Old Roman alphabet.

Single-stroke Roman letters.

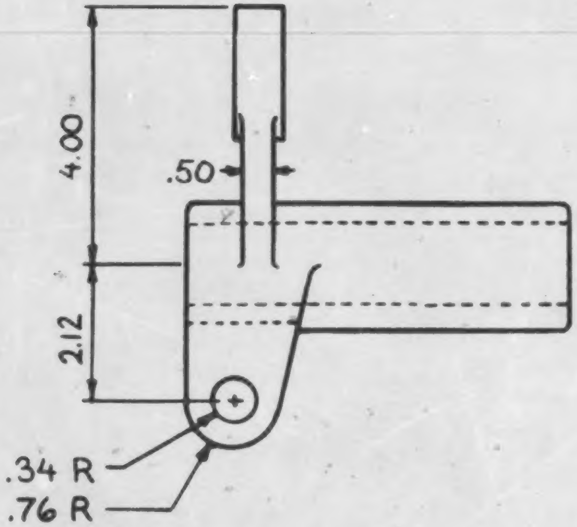

ABCDEFGHIJKLMN
OPQRSTUVWXYZ&
1234567890
abcdefghijklmnopqrstuvwxyz



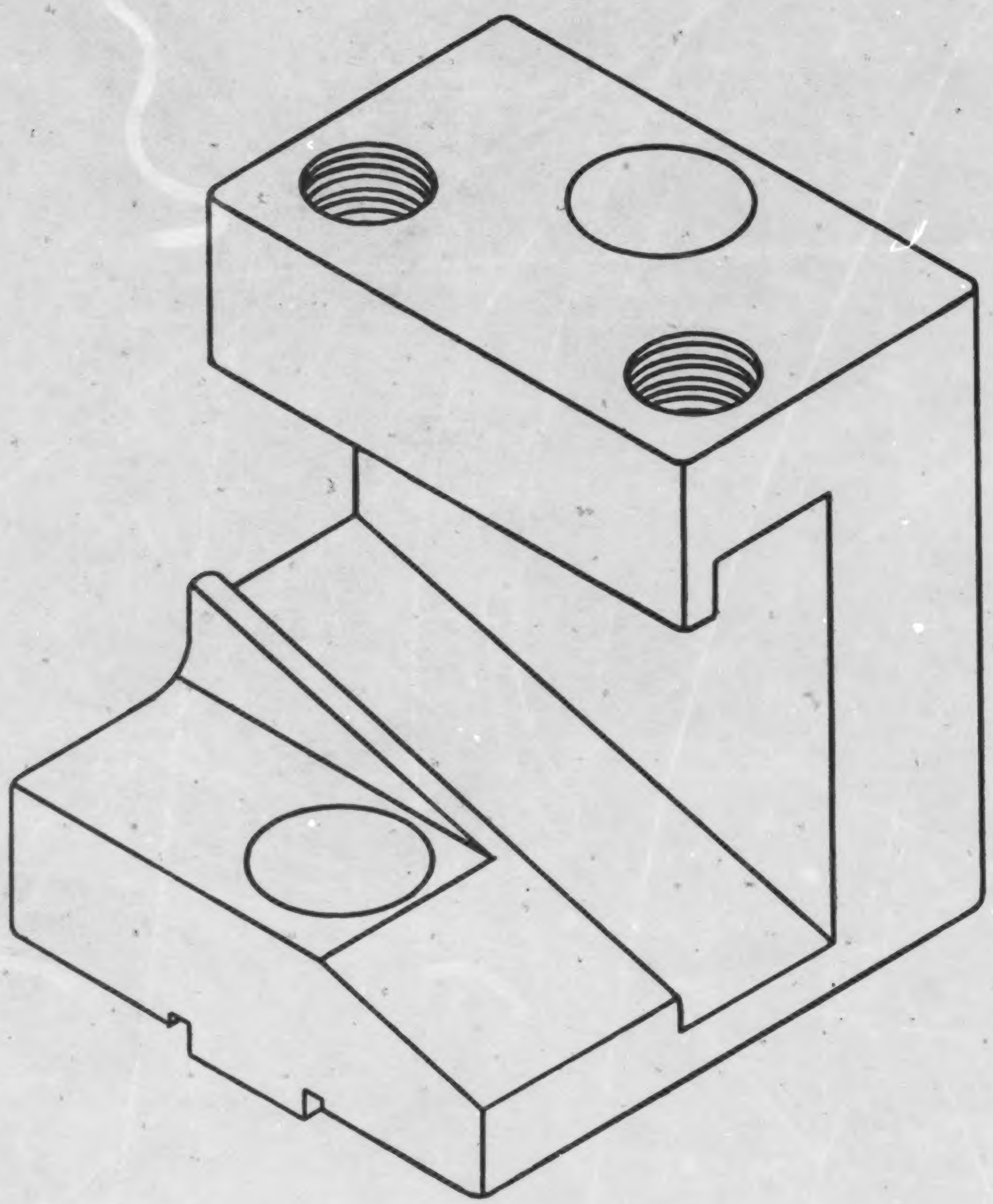
ISOMETRIC VIEW


6.00
4.50
.75
.75
4.00
2.75
.625 R
2.00 R
.50
.50

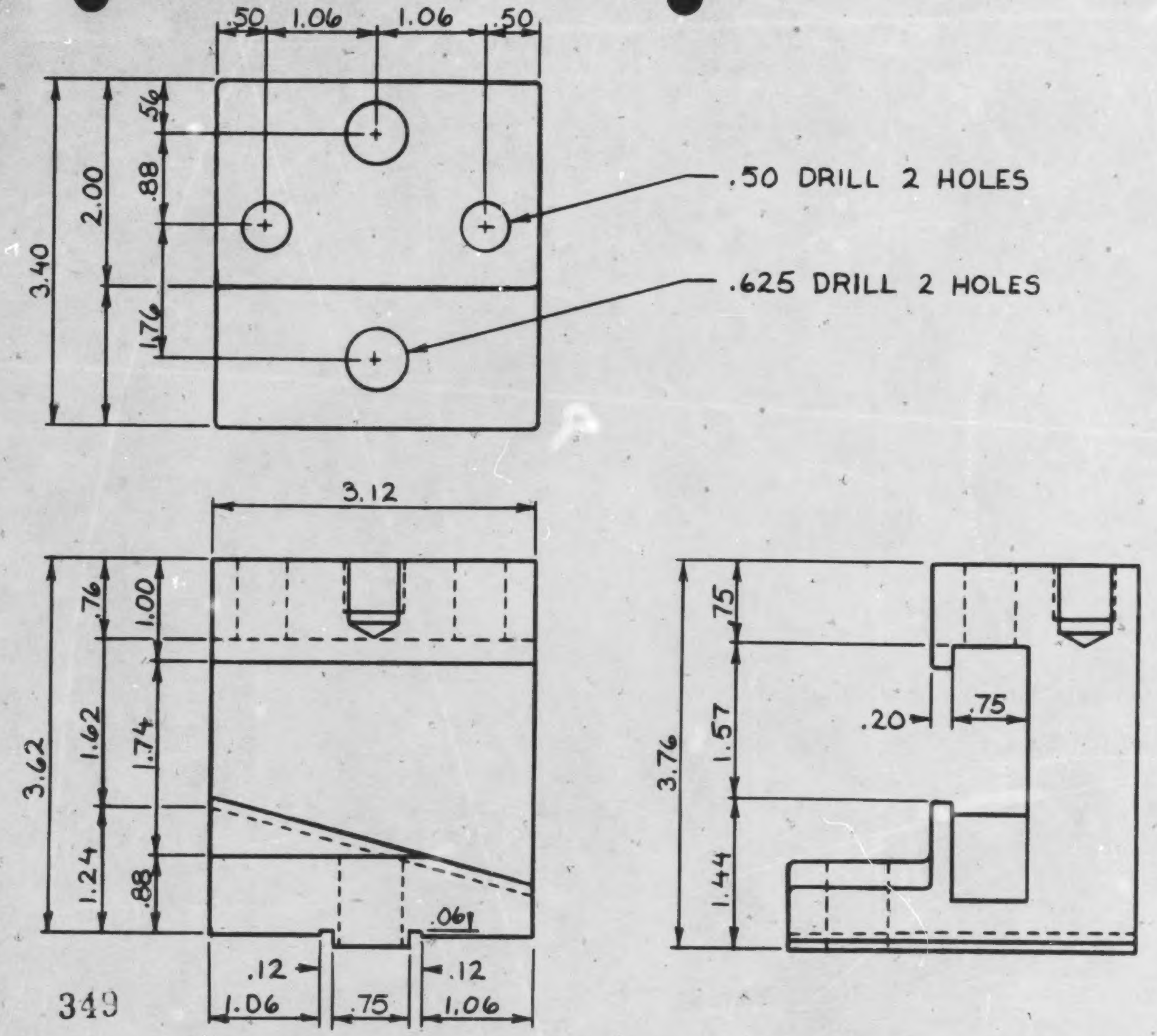
346


4.00
.50
2.12
.34 R
.76 R

347



ISOMETRIC VIEW


.50
1.06
1.06
.50
.56
.88
2.00
3.40
1.76
.50 DRILL 2 HOLES
.625 DRILL 2 HOLES
3.12
.76
1.00
1.62
1.74
3.62
1.24
.88
.061
.12
.12
1.06
.75
1.06
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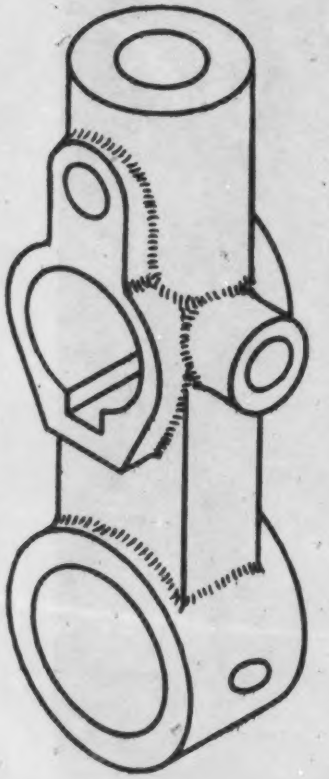
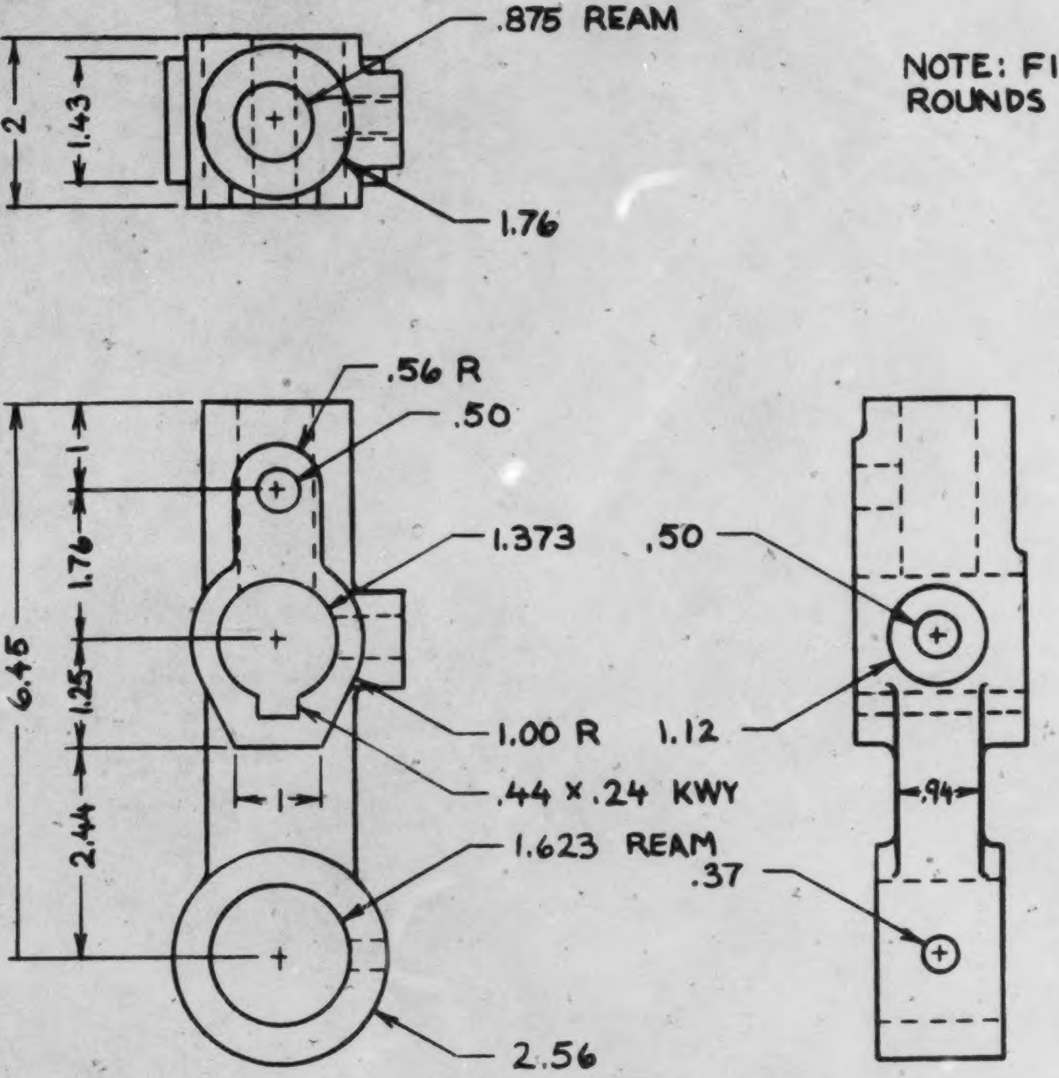
3.76
1.44
.20
.75

349

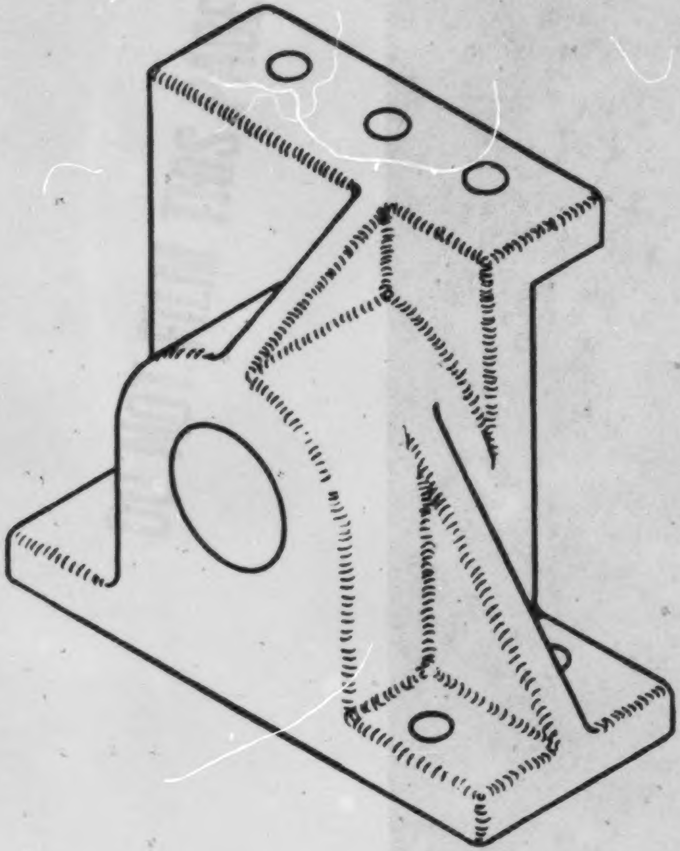
350



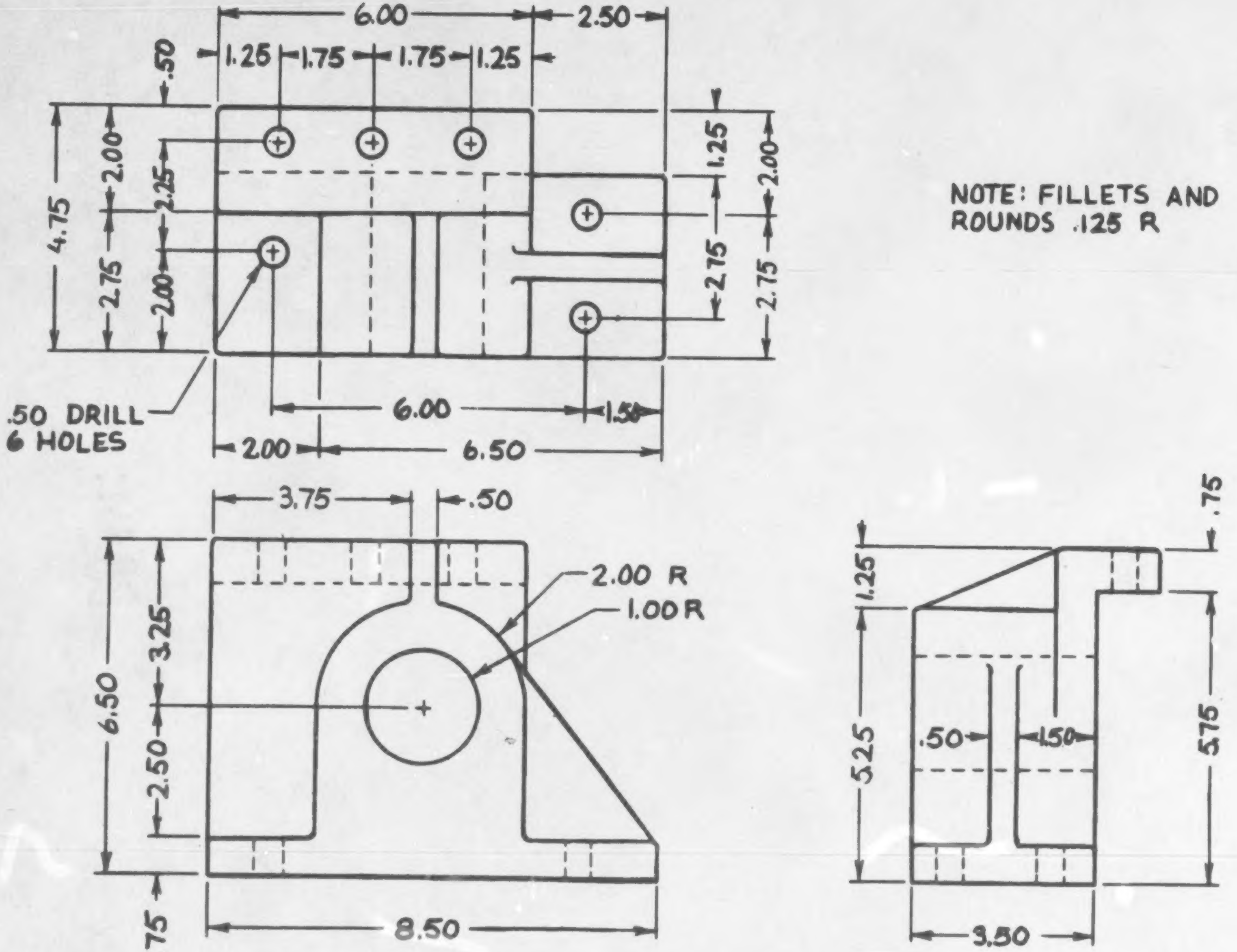
ISOMETRIC VIEW


.875 REAM
2
1.43
1.76
.56 R
.50
1
1.76
6.45
1.25
2.44
1.373
.50
1.00 R
1.12
.44 X .24 KWY
1
.94
1.623 REAM
.37
2.56

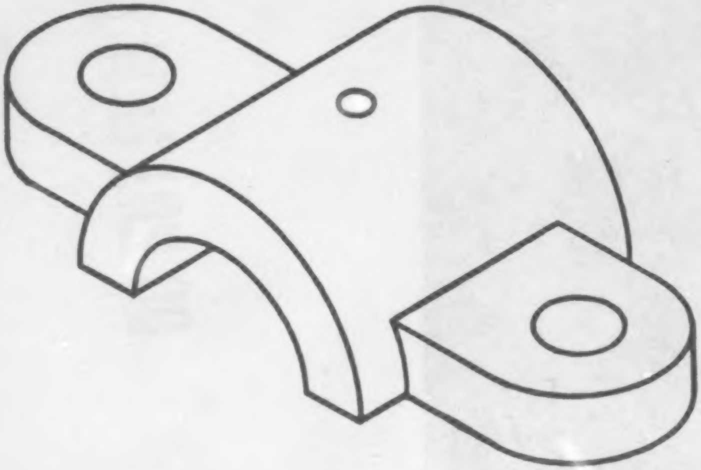
NOTE: FILLETS AND
ROUNDS .12 R



ISOMETRIC VIEW

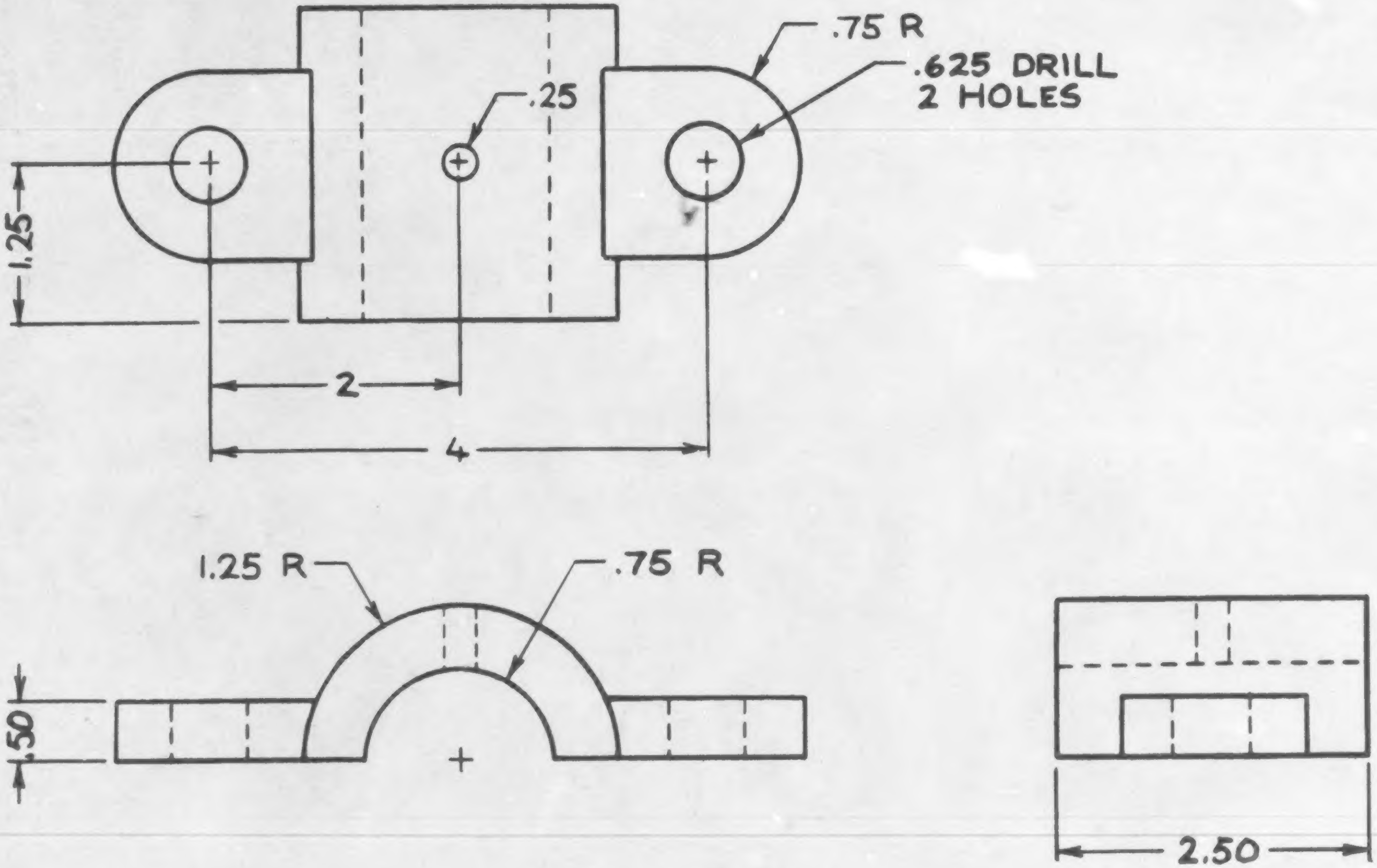

6.00
2.50
.50
1.25
1.75
1.75
1.25
2.00
2.25
4.75
2.75
2.00
1.25
2.00
2.75
2.75
.50 DRILL
6 HOLES
6.00
1.50
2.00
6.50
3.75
.50
2.00 R
1.00 R
6.50
3.25
2.50
.75
8.50
.75
1.25
5.25
.50
1.50
5.75
3.50

NOTE: FILLETS AND ROUNDS .125 R



ISOMETRIC VIEW

ORTHOGRAPHIC VIEWS


.75 R
.625 DRILL
2 HOLES
.25
1.25
2
4
1.25 R
.75 R
.50
2.50

STUDENT ACTIVITY SHEET #1

Using one square per letter, leaving a blank square between each letter and a blank row of squares between each line, copy the upper case, vertical, single-stroke Gothic alphabet and numbers from page 34, French and Svensen's, Mechanical Drawing, or whatever textbook or workbook they have or from the chalkboard. Do not copy the little arrows. Copy only the letters. Look at each example letter very carefully before copying it.

A B C D E F G H I J K L M N O P Q R S T
U V W X Y Z

DD 3.16

STUDENT ACTIVITY SHEET #2

Using on half or two squares for whole numbers and two squares, one above the other, practice making some fractions using the rules for making fractions in relation to whole numbers.

Example:

$1\frac{1}{2}$ $2\frac{7}{8}$ $3\frac{5}{16}$ $4\frac{3}{4}$ $5\frac{9}{16}$

STUDENT ACTIVITY SHEET #3

Leaving a blank row of squares between each lines and using the rules for spacing letters in words and words in sentences, copy the following sentences.

SPACE LETTERS IN WORDS CLOSE

TOGETHER.

LEAVE MORE SPACE BETWEEN

WORDS IN SENTENCES.

STUDENT ACTIVITY SHEET #4

Dimension the floor plan they made in Student Activity No. 10 of Unit 2.

UNIT TEST

I. Match the terms on the right with their definitions on the left.

_____1. Consists of one or more units; not a fraction.

_____2. The main guideline for letter from which the upper and lower guidelines are spaced.

_____3. Means straight up and down.

_____4. Its the running together of lines on a print.

_____5. Is the top guideline which the capitals must reach.

_____6. The big letters; the capitals.

_____7. Means the lines the letters are made with are the width of one stroke of the pencil or pen.

_____8. The big letters; upper case.

_____9. Little marks on the ends of lines in the Roman alphabet.

_____10. Refers to two numbers, one above the other with a bar between which represents part of a unit or whole number.

_____11. Refers to the lettering style that has no serifs.

_____12. Means easy to read.

_____13. Extremely light lines between which you put lettering.

_____14. Alphabet that has serifs.

A. Base line

B. "Bleeding"

C. Cap line

D. Capitals

E. Fraction

F. Gothic

G. Guidelines
t

H. Legible

I. Roman alphabe

J. Serifs

K. Single Stroke

L. Upper case

M. Vertical

N. Whole Number

II. In the following alphabet, circle the letters that are not single stroke Gothic:

A BC DEFGHIJKLMNOPORSTU
1234567890

III. Free hand letter the vertical, single-stroke Gothic alphabet upper case and numbers.

____

____

IV. Free hand letter five (5) examples of whole numbers and fractions:

V. Indicate in the space if the following statements about spacing letters in words are true or false.

_____ 1. All letters occupy the same amount of space.

_____ 2. Letters that have open space around them should be spaced closer to other letters than letters that do not have open space around them.

_____ 3. Letters with straight or closed sides are spaced the same as any other kind of letter.

_____ 4. In general space letters in words fairly close together.

VI. _____ The rule for spacing words together in sentences is simply leave more space between words because:

a. beginners tend to run words together.

b. it makes sentences more legible

c. practice will help achieve this

d. all of the above

ANSWERS TO TEST

I. 1. N
2. A
3. M
4. B
5. C
6. L
7. K
8. D
9. J
10. E
11. F
12. H
13. G
14. I

I

II. G I J 1 7

II. Refer to Information Sheets

IV. Refer to Information Sheets

V. 1. F
2. T
3. F
4. T

VI. D

EQUIPMENT AND SUPPLIES

Equipment:

1. Drawing board or smooth drawing surface
2. Straight edge
3. 45° triangle
4. 30° - 60° triangle
5. Architect's scale or 16th inch standard ruler

Supplies:

1. #4 drawing pencil with eraser if obtainable
2. Graph paper (Penworthy loose leaf filler graph paper).
3. Masking tape
4. Drawing paper

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section

DRAFTING

Title of unit:

CIVIL ENGINEERING

DESCRIPTION OF UNIT

This unit contains a brief history of Civil Engineering with an introduction to Civil Engineering surveying symbols and a presentation on the handling of a lot survey; its boundary, tree and vegitation location, and its contours.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify general Civil Engineering and Civil Engineering Technology terms, and participate in a discussion of the history and duties in Civil Engineering. The student will exhibit a working knowledge of Civil Engineering surveying symbols and definitions, and an understanding of the basic lot survey.

PERFORMANCE OBJECTIVE

After completion of this unit, the student will be able to:

1. Answer questions with 80% accuracy over the history of Civil Engineering and Civil Engineering Technology and its functions.
2. Exhibit knowledge of Civil Engineering surveying symbols and definitions.
3. Possess a basic understanding of a lot survey; its boundary, tree and vegetation location and its contours.

OUTLINE OF CONTENT

I. Drafting in Civil Engineering

The brief historical background to engineering activities reveals that the oldest branch of engineering is civil engineering, with its allied field of civil engineering technology. Today, twenty percent of all professional engineers are engaged in civil engineering work. The civil engineer is concerned primarily with the activities of man and his interactions with the environment. The civil engineering technologist is employed on projects designed to meet the needs of specific individuals.

The most prominent activity in the civil engineering field is structural design. Technologists involved in this activity are concerned with some phase of the design of buildings, dams, and bridges. Structures must be designed and constructed to withstand their own weight as well as such natural forces as earthquakes and winds, and they must be suited to the environments in which they are built. The need to accomodate extremes in climatic and environmental conditions constantly presents new problems and challenges to the engineering team concerned with structural design and construction.

Civil engineering technologists often are employed directly in supervising and monitoring the construction of various facilities. In these activities, it is necessary to see that the designs for the structures under construction are carried out exactly according to the plans. Additionally, the technician and technologist often are charged with maintaining the quality of the materials used in the construction procedure. The engineering technologist working in construction also supervises the use of such heavy equipment as trucks, cranes, earth movers, concrete mixing and placing equipment and other devices and machines.

Another key occupational area of the civil engineering technologist is the construction and operation of transportation facilities such as highways, airports and railroads. The technologist may be involved in the initial planning phases for such facilities, assisting the engineer in predicting the growth of population, the volume of anticipated traffic, potential future problems and possible alternate locations for transportation facilities. In these studies, the technologist will be called upon to give full attention to the environmental impacts of construction activities and operation of transportation facilities.

As in other fields where the construction of facilities is a necessary and important activity, in transportation engineering the technologist will be involved in constructing facilities efficiently under varying conditions of terrain and climate. He will be involved in surveying and mapping and in the supervision of construction. Finally, he also may be involved in the analysis of transportation systems to insure the maximum efficiency of completed networks.

One of the oldest and most important areas of interest for civil engineers and technologists is that of hydraulics-the management of water resources. Included in this area of activity are the collection, control, use and conservation of water. Floor control, drainage, reclamation and irrigation projects are planned and designed by civil engineers and technologists who are specialists in hydraulics, as are navigation projects, water storage projects, and hydroelectric power plants.

One of the most important areas of activity of the civil engineering technologist in this area is his work in assuring safe drinking water supplies and effective sewage and wastewater disposal systems. With populations becoming more concentrated and modern industry growing rapidly, the amounts and kinds of pollutants introduced into rivers and streams and other areas of the environment assure that engineers and technologists working in the area of water supply and wastewater treatment will find new challenges of ever-greater complexity.

In recent years, there has been a population shift from the country to the city, and because of this, many of the activities of the civil engineering technologist working in construction, in structural design, in transportation, and in water management will be focused in population centers. Some of the technologists in this area devote their time primarily to working with city planners and urban development agencies, assisting them in formulating plans for growth and the management of urban areas.

The activities described in the proceding paragraphs do not include all of the possible activities in which a civil engineering technologist may be engaged after graduation. However, from those listed, the prospective technologist should be able to get some appreciation of the wide variety of possibilities within this broad field of technology.

The object and purpose of this section on Civil Engineering is to acquaint the student with, and give him a working practical knowledge of the drawings and related calculations that are connected with plane surveying. Plane surveying deals with areas of limited extent where it is unnecessary to consider the curvature of the earth. It deals with the relative location of points on or near the earth's surface. Geodetic surveying takes into consideration the shape of the earth and this unit will not go into that part of civil engineering.

It is assumed that the student is familiar with the use and care of drafting instruments and equipment such wehre used in preceding sections in mechanical drafting. Greater care in the execution of the drawings of civil engineering is usually required than in ordinary mechanical or architectural drafting. In order to keep the desired consistent relation between the field measurements and the completed map, considerable care and skill in plotting and drafting is required.

In mechanical drafting, dimensions are usually noted and scaled dimensions from the drawings are not frequently used. In the drawings connected with civil engineering, many dimensions are omitted and it is necessary for the users of the maps to rely on scaled distances and angular values that are obtained by measurement from the map.

II. Drawings of Civil Engineering

The ordinary drawings connected with plane surveying in civil engineering consist of maps, profiles and cross-sections.

III. Maps

A map is a graphical representation, by means of lines and symbols, of a certain portion of the earth's surface. Since the earth's surface is curved, the shape of the earth being that of an oblate spheroid of revolution, and the surface must be presented on the plane of a sheet of paper, there will always be some distortion in the finished map. In the relatively small areas considered in plane surveying, this distortion cannot be measured by ordinary means. The drawings are therefore made as though the earth's surface, over the area being surveyed and mapped, is flat. All measurements made in surveying are horizontal measurements or the measurements are reduced to the equivalent horizontal measurements before being used in map plotting.

IV. Profiles

A profile in survey drafting is a drawing showing a vertical section along a certain surveyed line. These are usually made by plotting the elevations of points located at relatively short measured distances along a certain located line, such as the center line of a highway, railroad or canal. An elevation, as the term is used in surveying, is the vertical distance of a point above or below a fixed reference plane. The reference plane most commonly used in surveying is mean sea level. Profiles are along and in the direction of the line surveyed and are plotted as a vertical section. Horizontal and vertical scales are necessary. The roughness of the earth's surface along the line surveyed determines the scales to be used. The horizontal and the vertical scales used are not usually the same. Profiles are usually plotted on squared, cross-section paper, or plan-profile paper.

V. Cross Sections

A cross-section is a drawing showing a vertical section usually at right angles to the survey line. Information for plotting cross-sections is obtained by running elevations along lines usually located at right angles to the survey lines and out to a sufficient distance on each side of the survey line to obtain the desired information. Reading for elevations are taken on the cross-line at places where there is a change in the slope of the terrain. Another method is to take different readings and record the elevations only where the readings show a selected contour value. The cross-lines to the survey line are spaced or located at whole station numbers on the survey line and at changes in direction of the survey line. These cross-lines are also placed at any other locations along the line where additional information is desired or the topography indicates that they are needed. The purpose of the cross-lines are to furnish information for location studies, earthwork calculation, drainage studies and locations. They give primary information to determine the shape and configuration of the ground surface on each side of the survey line.

VI. Traverses

The expression "traverse" has been mentioned in the preceding discussion. A traverse is, as used in surveying, a succession of points, at more or less regular measured intervals, connected by straight lines the directions of the lines and the distances between points having been measured. There are two types of traverses. A traverse that begins at a certain point and returns to the point of beginning is called a "closed traverse". This is the type traverse encountered in the survey of a tract or parcel of land. A traverse that does not return to the pont of beginning is shown as an "open" or "continuous traverse". Station numbers are usually used to indicate distances along an open traverse. A station is a unit of 100 feet. This is known as a full station. The fractional part of a full station is known as a plus station. The beginning or starting point in an open traverse is called station 0+00. Open traverses are usually numbered in stations continuously from the beginning point to the end of the traverse. A point at a distance of 782.52 from the beginning of an open traverse would be numbered 7+82.52. The seven indicates the number of full stations and the 82.52 indicates the fractional part of a full station.

During the operation of running a traverse, stakes or markers are set at regular intervals on the line, usually 100 feet apart. Sometimes the distance between stakes are reduced to 50 feet or 25 feet or less. Each line on a traverse is known as a course.

Examples of open traverses are the surveys for highways, railways, canals and pipelines.

VII. Distances

Distances are measured in the field with a steel tape, usually 100 feet long. The process of measuring distances is called taping or chaining. Distances are almost always measured in feet. Another unit of measurement used widely at one time was the Gunter's chain. This was a linked wire chain which was 66 feet long broken down into 100 links. Each link was 7.92 inches long. This unit of measurement was used, by law, in the original surveys authorized by the U.S. Government.

Two types of measurement of angles and distances are encountered. These are observed quantities which are actually observed or measured in the field. The others are calculated quantities which are calculated from measured quantities.

The actual distance between any two stations is found by subtracting the smaller station number from the larger station number.

In closed traverses, the actual distances between changes in directions of the lines are recorded in feet instead of station numbers.

All measurements made during the survey are recorded as they are made in a durable notebook. The notebook is known as a Field Book. Notes and figures from this field book are used by the draftsman in making the drawings and maps required. Erasures are not permitted in a field book. A line is drawn through the figure to be corrected and a new figure written.

VIII. Kinds of Maps

It has been stated before that a map is a graphical representation, by means of lines and symbols, of a portion of the earth's surface. A the location of objects, both natural and artificial, on or near the surface of the earth.

There are several types of maps such as topographic, geographic, planimetric, real estate, road maps, and survey maps and many others. If the shape or configuration of the grund surface is shown or indicated on the map, it is known as a topographic map. If the relief of the ground surface is not shown on the map, it is known as a planimetric map. Geographic maps show the location of communities, roads, railroads, political subdivisions and much other information.

IX. Scales

Practically all drawings related to surveying are drawn to scale, that is, a certain distance on the map represents a proportional distance on the ground. The ratio of a distance on the map to the corresponding distance on the ground is known as the scale of the map. We may state the scale of 1" on the map represents 100 ft. on the ground or 1 inch represents any other desirable distance on the ground. The scale may also be stated in another manner such as 1/5000. This means that one unit of measurement on map represents 5000 units of measurement on the ground, the same units of measurement being used, whether they be inches, yards or miles. Another type scale used is a graphical scale. The scale is drawn on the map and represents actual distances. The advantage of this scale is that any distortion due to shrinkage or expansion of the paper also distorts the scale equally and the scale or ratio remains true. A noted scale is one that states that 1 inch represents so many feet such as 1 inch equals 1000 feet. This means that one measured inch on the map represents 1000 feet on the ground.

X. North

All maps should show in which direction the north is, in order that the user may orient the map with direction on the ground. The north is indicated by an arrow with the head pointing north.

XI. Titles

Each map should include a title. This gives enough information for the map to be used intelligently. The title should show the name or subject of the map, the authority or who made the map, the direction of the meridian, the scale and any other information needed to use the map.

If conventional signs out of the usual are used, a legend is given showing exactly what the signs or symbols mean or represent. Anything shown out of the ordinary should be explained by a notation at a convenient place on the map.

XII. Symbols

Objects are represented on a map by certain signs and symbols. Many of these are conventional, that is they are so widely used that they are easily recognized. When a certain sign or symbol becomes accepted widely to mean a certain feature or structure it becomes conventional. The student will soon make a plate showing many generally accepted signs and symbols to represent objects.

XIII Lettering

Lettering on a map is of great importance. Poor lettering will ruin the appearance of an otherwise perfect drawing. Good lettering ability can be acquired only by studied and frequent practice. It is assumed here that the student has learned the principles of lettering in a previous unit in drawing and can continue with the required practice to become skilled in lettering.

XIV. Notes and Legends

Notes and legends are used on a map for explanatory purposes to avoid any doubt in the map users mind. They should be brief but clearly understandable. A key to any but widely accepted symbols should be shown on the map. An acceptable place for notes and legends is near the title block where they are easily seen.

TEACHER ACTIVITIES

I. Make transparencies, if not provided.

II. Discuss unit and specific objectives of Civil Engineering and Civil Engineering Technology.

III. Cover contents and give presentation on symbols when the subject is presented.

IV. Emphasize importance of surveying and show transparencies on basic lot survey.

V. For evaluation list symbols on chalk board and ask for the definitions.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study Information sheet No. 1

III. If provided, study unit contents.

IV. Take test.

REFERENCES/RESOURCES

I. References

A. Heer, John and Hagerty, Joseph, Engineering Technology, Skokie, Illinois, VGM Career Horizons, 1979.

B. Appreciation to: State of Louisiana Vocational Curriculum Development and Research Center.

INFORMATION SHEET NO. 1

I. Drafting in Civil Engineering

The brief historical background to engineering activities reveals that the oldest branch of engineering is civil engineering, with its allied field of civil engineering technology. Today, twenty percent of all professional engineers are engaged in civil engineering work. The civil engineer is concerned primarily with the activities of man and his interactions with the environment. The civil engineering technologist is employed on projects designed to meet the needs of specific individuals.

The most prominent activity in the civil engineering field is structural design. Technologists involved in this activity are concerned with some phase of the design of buildings, dams, and bridges. Structures must be designed and constructed to withstand their own weight as well as such natural forces as earthquakes and winds, and they must be suited to the environments in which they are built. The need to accomodate extremes in climatic and environmental conditions constantly presents new problems and challenges to the engineering team concerned with structural design and construction.

Civil engineering technologists often are employed directly in supervising and monitoring the construction of various facilities. In these activities, it is necessary to see that the designs for the structures under construction are carried out exactly according to the plans. Additionally, the technician and technologist often are charged with maintaining the quality of the materials used in the construction procedure. The engineering technologist working in construction also supervises the use of such heavy equipment as trucks, cranes, earth movers, concrete mixing and placing equipment and other devices and machines.

Another key occupational area of the civil engineering technologist is the construction and operation of transportation facilities such as highways, airports and railroads. The technologist may be involved in the initial planning phases for such facilities, assisting the engineer in predicting the growth of population, the volume of anticipated traffic, potential future problems and possible alternate locations for transportation facilities. In these studies, the technologist will be called upon to give full attention to the environmental impacts of construction activities and operation of transportation facilities.

As in other fields where the construction of facilities is a necessary and important activity, in transportation engineering the technologist will be involved in constructing facilities efficiently under varying conditions of terrain and climate. He will be involved in surveying and mapping and in the supervision of construction. Finally, he also may be involved in the analysis of transportation systems to insure the maximum efficiency of completed networks.

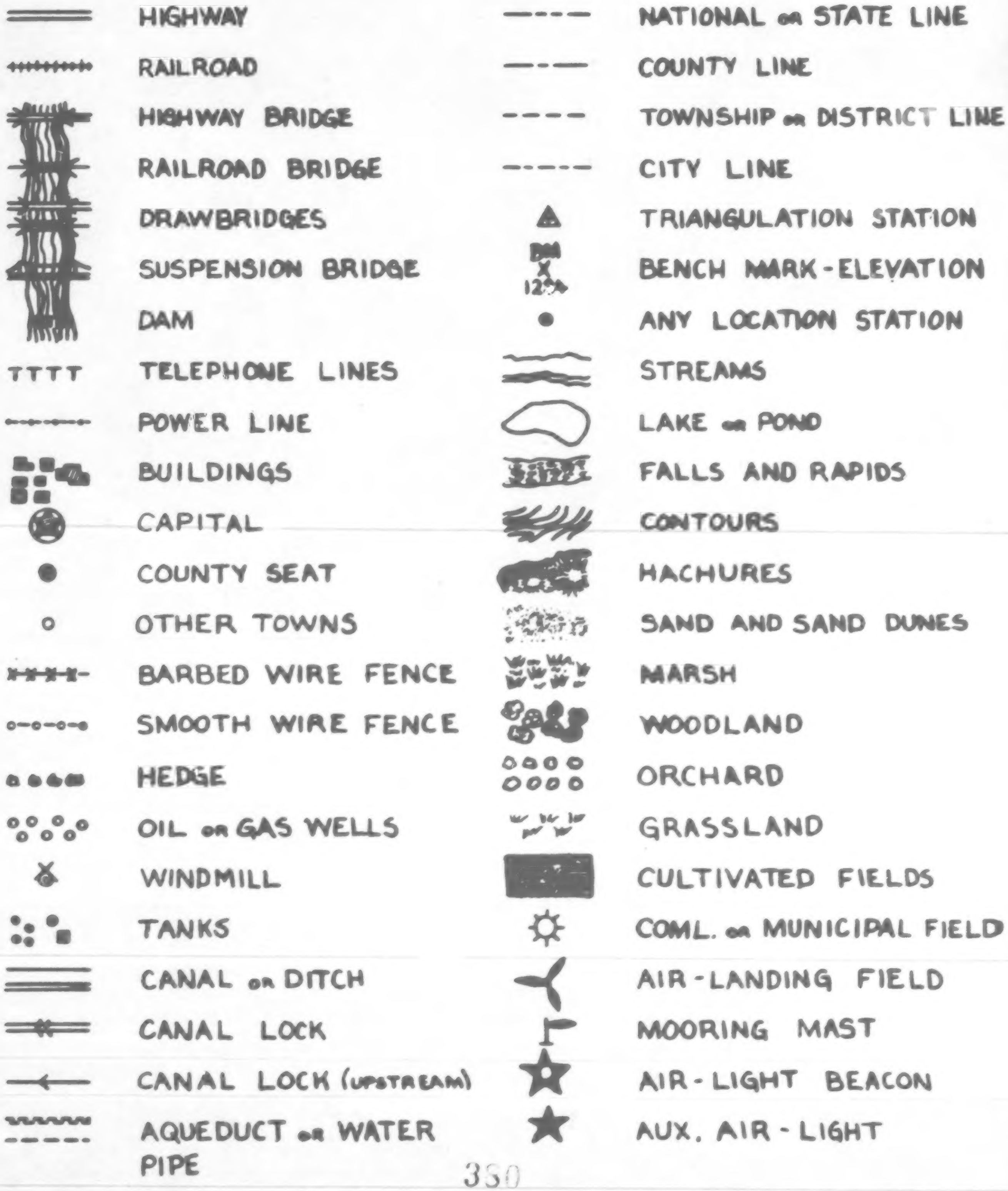
One of the oldest and most important areas of interest for civil engineers and technologists is that of hydraulics-the management of water resources. Included in this area of activity are the collection, control, use and conservation of water. Floor control, drainage, reclamation and irrigation projects are planned and designed by civil engineers and technologists who are specialists in hydraulics, as are navigation projects, water storage projects, and hydroelectric power plants.

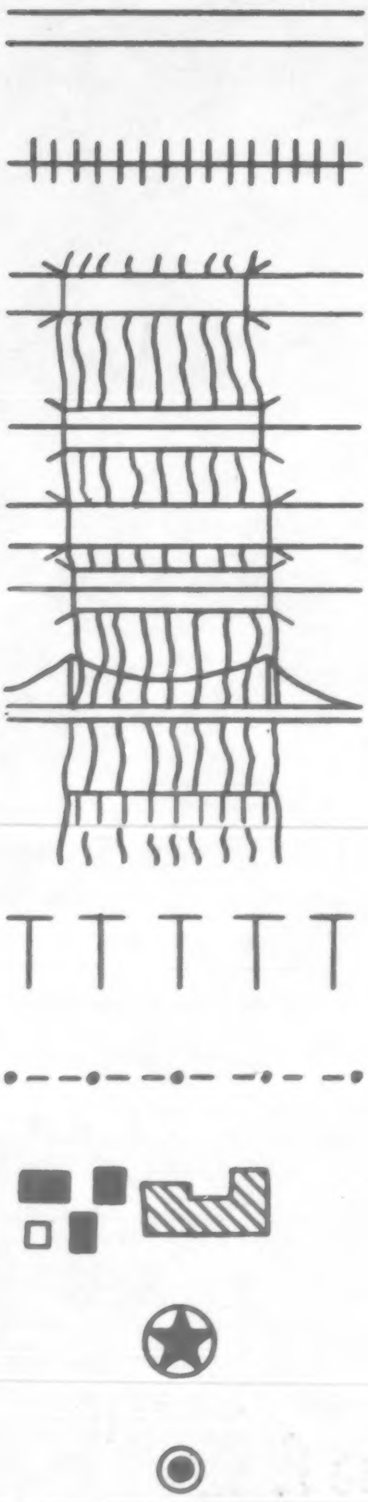
One of the most important areas of activity of the civil engineering technologist in this area is his work in assuring safe drinking water supplies and effective sewage and wastewater disposal systems. With populations becoming more concentrated and modern industry growing rapidly, the amounts and kinds of pollutants introduced into rivers and streams and other areas of the environment assure that engineers and technologists working in the area of water supply and wastewater treatment will find new challenges of ever-greater complexity.

In recent years, there has been a population shift from the country to the city, and because of this, many of the activities of the civil engineering technologist working in construction, in structural design, in transportation, and in water management will be focused in population centers. Some of the technologists in this area devote their time primarily to working with city planners and urban development agencies, assisting them in formulating plans for growth and the management of urban areas.

The activities described in the proceding paragraphs do not include all of the possible activities in which a civil engineering technologist may be engaged after graduation. However, from those listed, the prospective technologist should be able to get some appreciation of the wide variety of possibilities within this broad field of technology.
Another old area of interest to civil engineers is surveying, and it is with this area that the rest of this unit will deal.

TOPOGRAPHIC SYMBOLS


HIGHWAY
RAILROAD
HIGHWAY BRIDGE
RAILROAD BRIDGE
DRAWBRIDGES
SUSPENSION BRIDGE
DAM
TTTT
TELEPHONE LINES
POWER LINE
BUILDINGS
CAPITAL
COUNTY SEAT
OTHER TOWNS
BARBED WIRE FENCE
SMOOTH WIRE FENCE
HEDGE
OIL OR GAS WELLS
WINDMILL
TANKS
CANAL OR DITCH
CANAL LOCK
CANAL LOCK (UPSTREAM)
AQUEDUCT OR WATER PIPE
NATIONAL OR STATE LINE
COUNTY LINE
TOWNSHIP OR DISTRICT LINE
CITY LINE
TRIANGULATION STATION
BM
X
1234
BENCH MARK-ELEVATION
ANY LOCATION STATION
STREAMS
LAKE OR POND
FALLS AND RAPIDS
CONTOURS
HACHURES
SAND AND SAND DUNES
MARSH
WOODLAND
ORCHARD
GRASSLAND
CULTIVATED FIELDS
COML. OR MUNICIPAL FIELD
AIR-LANDING FIELD
MOORING MAST
AIR-LIGHT BEACON
AUX. AIR-LIGHT



HIGHWAY

RAILROAD

HIGHWAY BRIDGE

RAILROAD BRIDGE

DRAWBRIDGES

SUSPENSION BRIDGE

DAM

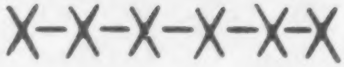
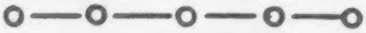
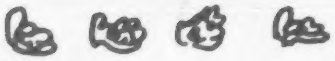
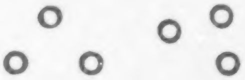
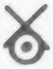
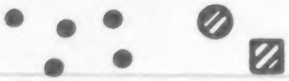
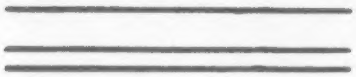
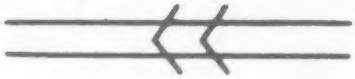
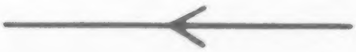
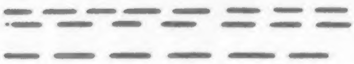
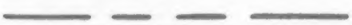
TELEPHONE LINE

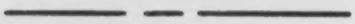
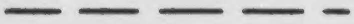
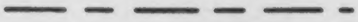
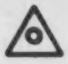
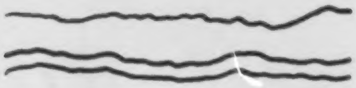
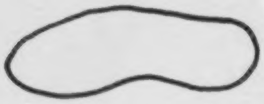
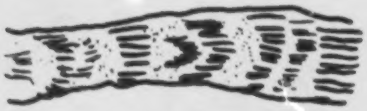
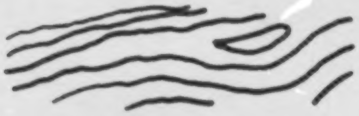
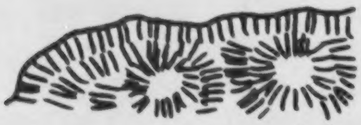
POWER LINE

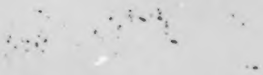
BUILDINGS

CAPITAL

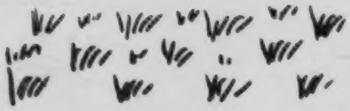
COUNTY SEAT

	TOWNS
	BARBED WIRE FENCE
	SMOOTH WIRE FENCE
	HEDGE
	OIL WELLS
	WINDMILL
	TANKS
	CANAL OR DITCH
	CANAL LOCK
	CANAL LOCK (UPSTREAM)
	AQUEDUCT / WATER PIPE
	STATE LINE

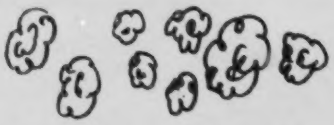
	COUNTY LINE
	DISTRICT LINE
	CITY LINE
	TRIANGULATION STA.
BM × 1234	BENCH MARK AND ELEV.
	ANY LOCATION STA.
	STREAMS
	LAKE OR POND
	FALLS AND RAPIDS
	CONTOURS
	HACHURES



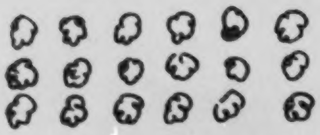
SAND AND SAND DUNES



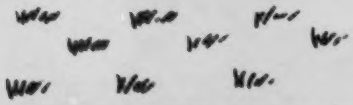
MARSH



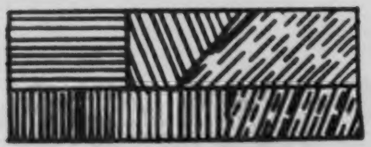
WOODLAND



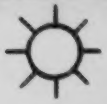
ORCHARD



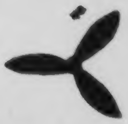
GRASSLAND



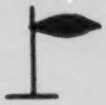
CULTIVATED FIELDS



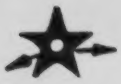
COML. OR MUN. FIELD



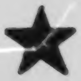
AIR LANDING FIELD



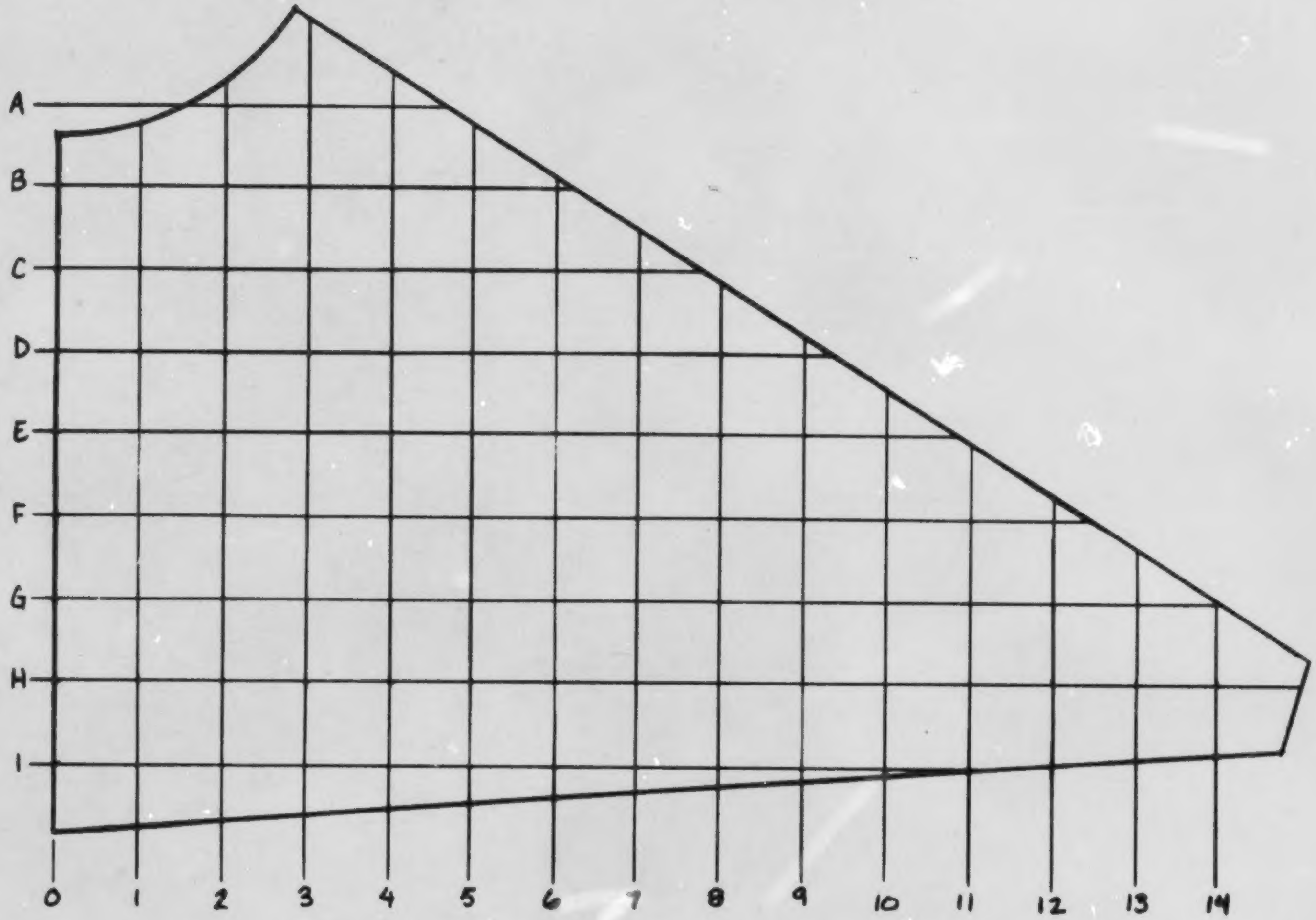
MOORING MAST



AIR LIGHT BEACON



AUX. AIR-LIGHT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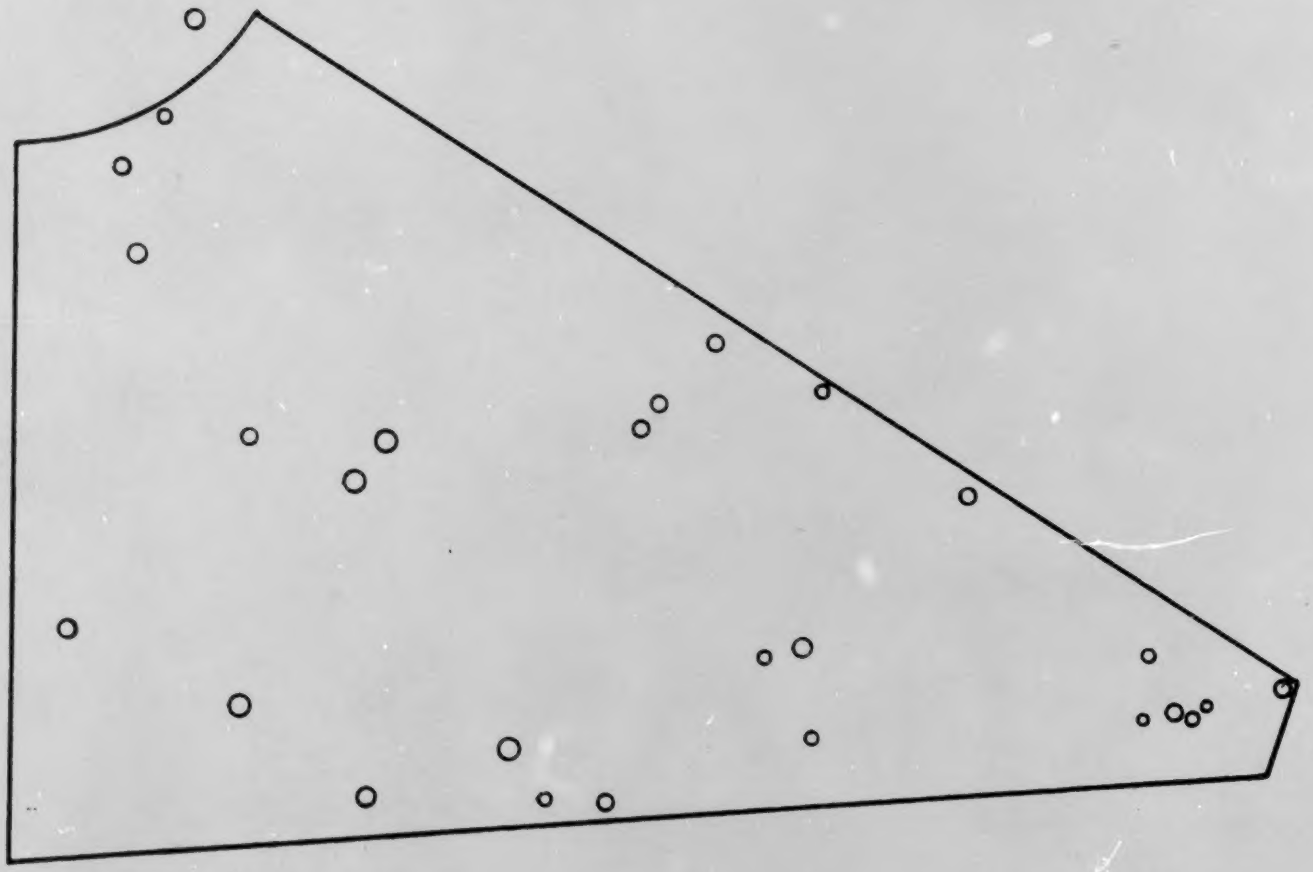
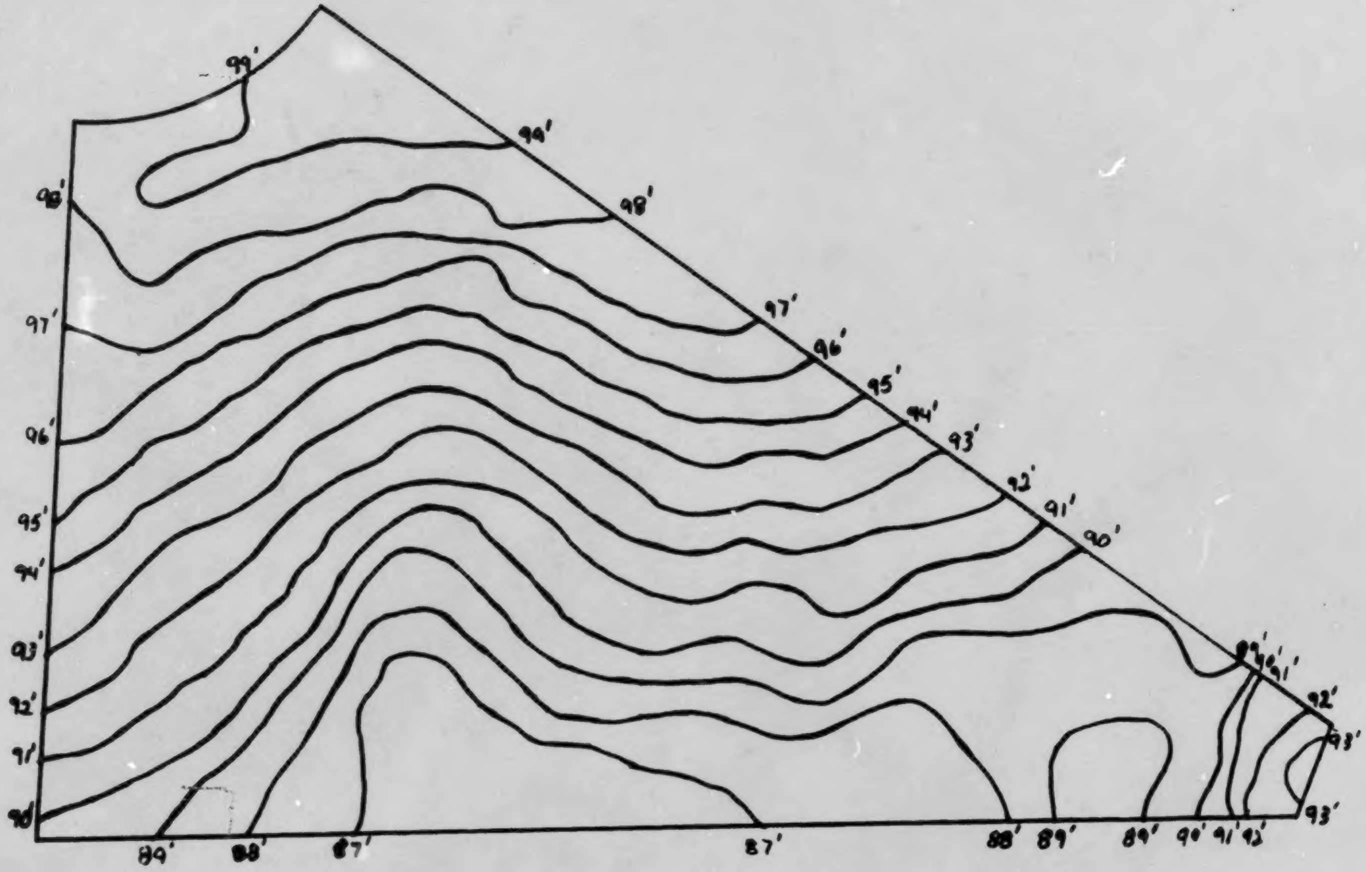
GRID LINES

T.M.-6 / DD 4.12-F



38

VEGITATION & TREE LOCATION


99'
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95'
95'
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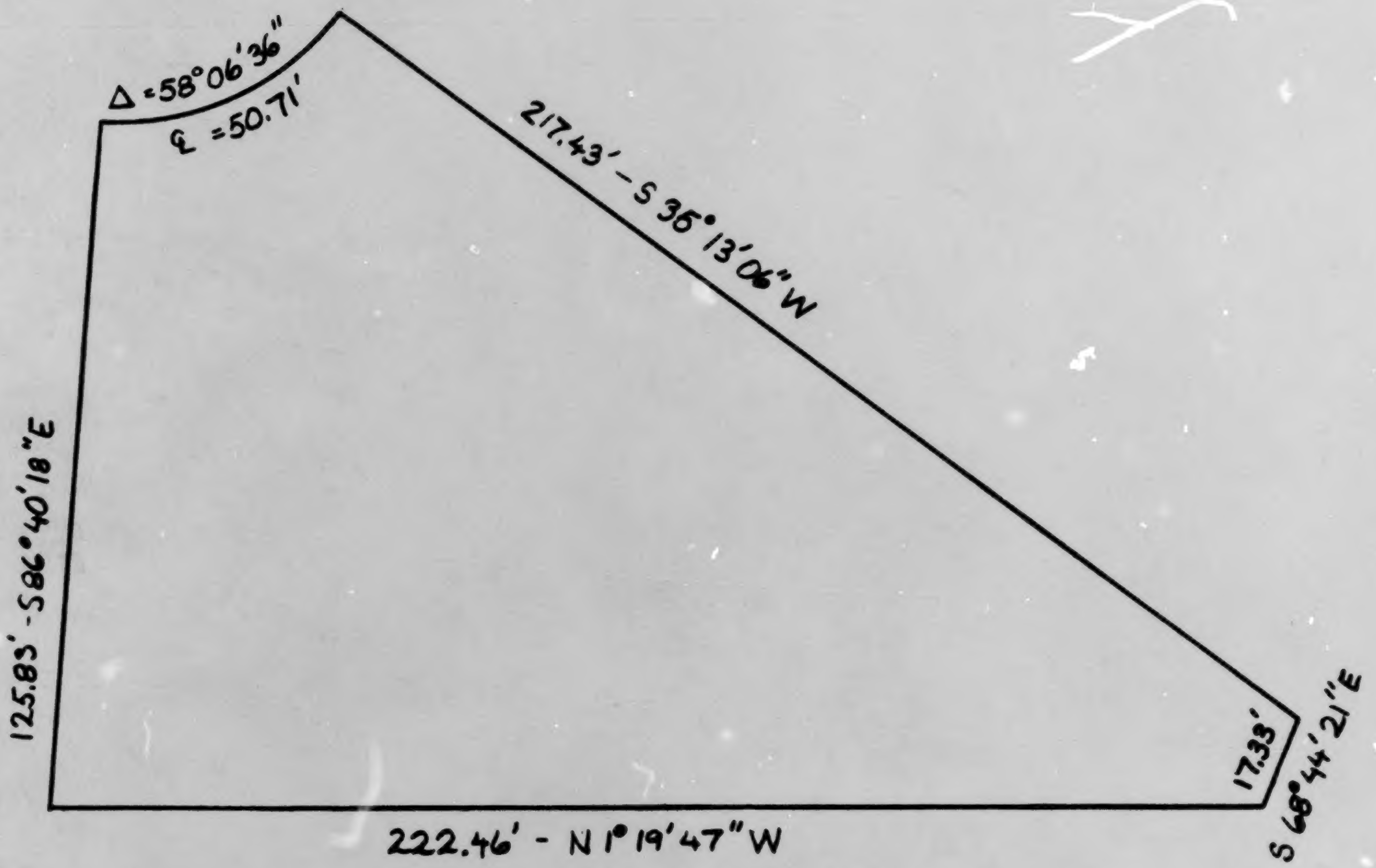
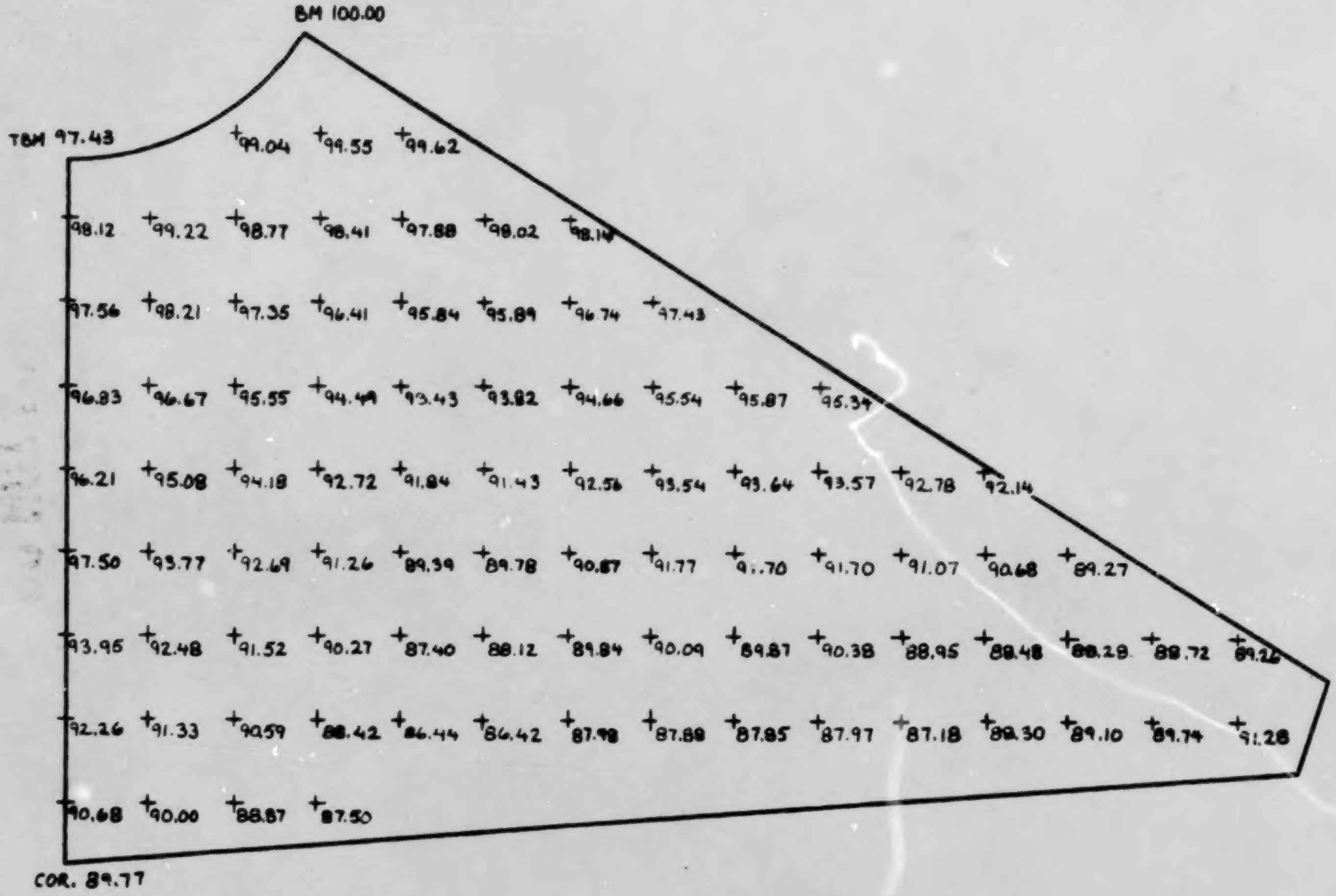
92'

CONTOURS


Δ =58°06'36"
L =50.71'
217.43' - S 35°13'06"W
125.83' - S86°40'18"E
17.33'
S 68°44'21"E
222.46' - N 1°19'47"W

BEARINGS & DISTANCES



BM 100.00
TBM 97.43
99.04
99.55
99.62
98.12
99.22
98.77
98.41
97.88
98.02
98.14
97.56
98.21
97.35
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96.67
95.55
94.49
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93.82
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95.54
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95.08
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92.56
93.54
93.64
93.57
92.78
92.14
97.50
93.77
92.69
91.26
89.39
89.78
90.87
91.77
91.70
91.70
91.07
90.68
89.27
93.95
92.48
91.52
90.27
87.40
88.12
89.84
90.09
89.87
90.38
88.95
88.48
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88.72
89.26
92.26
91.33
90.59
88.42
86.44
86.42
87.98
87.88
87.85
87.97
87.18
88.30
89.10
89.74
91.28
90.68
90.00
88.87
87.50
COR. 89.77

ELEVATIONS

UNIT TEST

Place Civil Engineering Surveying symbols on chalk board and ask students to copy symbol and provide definition.

EQUIPMENT AND SUPPLIES

1. Ordinary #2 pencil with eraser.
2. Ordinary tablet or notebook paper.
3. A more or less smooth, flat surface to draw on.
4. Ruler and straight edge.
5. Symbols on handout mimeograph paper or chalk board.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

DRAFTING

Title of Unit

OTHER ENGINEERING SPECIALTIES

DESCRIPTION OF UNIT

This unit contains brief descriptions of various engineering specialties and their functions.

UNIT OBJECTIVE

After completion of this unit the student will possess an understanding of several engineering specialties not discussed in the first four units. This unit is intended to be a conclusion to this instructional section and should be evaluated comprehensively with the previous four units.

PERFORMANCE OBJECTIVES

After completion of this unit the student will have acquired a basic knowledge of a variety of engineering specialties.

OUTLINE OF CONTENTS

I. Electrical Engineering

As mentioned previously, electricity was first used to supply illumination and to permit communications over long distances. However, these uses of electricity are being replaced rapidly by the use of electricity to furnish power for industrial and domestic use. A student who is interested in a career in electrical engineering technology may wish to consider working in the field of electrical power generation and transmission or in the use of electrical power in the home or in an industry. Technologists might also be involved in the development of communications systems or new and more efficient lighting systems based upon electricity and electronics.

The development of communications technology as a distinct area within electrical engineering technology has been very rapid during the last fifty years and continues at a great pace. The sequence of communications devices based upon electricity and electronics includes the telegraph, the telephone, the wireless set, the radio, motion pictures with sound, telephoto transmitters, and television. These devices have been developed and manufactured in greater complexity with more reliability and at lower costs with each succeeding year. Electrical engineering technologists can participate in the development and testing of new communication devices as well as supervision of the manufacturing of already developed devices. Additionally, electrical engineering technologists specializing in communications may be involved in the generation, transmission, and reception of electro-magnetic waves through radio and television stations and other communication facilities. Thus, one of the oldest uses of electrical technology continues to be one of the most important.

In addition to the direct use of electricity to power industry and to furnish light and heat in homes, electrical phenomena are being utilized in even greater sophistication and complexity to control and monitor industrial processes, living conditions, and many other processes. Many of these sophisticated instrumentation systems are based upon electronics.

Electrical engineering technologists who are involved in electronics will assist in the design, manufacture, and use of various types of vacuum tubes and solid state electronic devices. In addition, they can assist engineers in designing and testing new electronic devices designed for communications or for instrumentation.

One of these uses for electronic devices is too important that it deserves special consideration. This is the use of electronic and electricity devices in the modern digital and analog computers. Because of the capability of performing complex operations very rapidly through the use of electronic circuits, electrical engineers and technologists have developed very small computers which are capable of performing complex calculations and computations in fractions of a second. The electrical engineering technologist is almost certain to become involved in some way in the design, manufacture, or use of such devices if this area of activity is of interest to him. The use of microprocessors and minicomputers in this field is one of the most rapidly growing areas of technology today and promises a growing future for electrical engineering technologists.

II. Chemical Engineering

Chemical engineering technologists are involved with the preparation, separation, and analysis of chemical substances. They often engage in the study of the composition and changes in composition of natural and man-made substances. In these activities, the chemical engineering technologist relies heavily on a background in chemistry. However, his activities are not limited to the preparation and analysis of chemical substances. The chemical engineer, as opposed to the chemist, is concerned with the maximum utilization of raw materials to mass-produce substances through the use of technology to control chemical and physical processes. Technologists work with chemical engineers in the development of new products, the design of new processes, and the planning and operation of chemical plants. They may be employed in assisting chemical engineers in the manufacture and analysis of each chemicals as salts, acids, or alkalies, all of which are used in great quantities in modern manufacturing processes.

Technologists in chemical engineering also may be involved in the refining of such natural materials as petroleum and rubber. Petroleum is utilized as a fuel in such forms as natural gas, gasoline, kerosene, and fuel oil. The chemical engineering technologist may be involved in some way in the refining and purifying of petroleum fuels, as well as in the manufacture of chemicals from petroleum (petrochemicals). This is a growing field in which chemical engineering technologists are being employed in ever-greater numbers.

Other growing fields of manufacture and development in the chemical engineering industry include the development of biochemicals produced in nature by plants and animals. The chemical engineering technologist working in this area would be one who is interested in developing chemicals produced in nature in great quantity, at a reasonable cost, with a high degree of purity. In other words, the technologist is employed in trying to reproduce, in full-scale manufacturing plants, the biochemical processes which occur in nature.

In all of the activities previously mentioned, the technologist is involved in the production of a given chemical substance through the control of a chemical and physical process. Because of the importance of process control, many technologists also are employed in the study and perfection of basic chemical and physical processes called unit operations. Unit operations include chemical reactions, separation processes, heat and mass transfer processes. Chemical engineering technologists assist in the control and perfection of chemical reactions within engineering plants and also are concerned with the design of separation equipment and with the development of control systems for the separation process.

One of the most important applications of this type of unit operation combines the work of the chemical engineering technologist with that of the civil engineering technologist. These professionals collaborate in the use of separation operations to purify drinking water and to treat sewage waste. In utilizing various unit operations, chemical engineering technologists try to make reactions proceed as rapidly as possible, with the lowest input of energy, to achieve the greatest efficiency and the lowest cost.

III. Other Engineering Specialties

In addition to the fields mentioned above, other specialized areas of interest have developed in engineering technology as a result of a combination of efforst in the older branches listed above and in response to specialized needs. For example, one branch of engineering technology called materials engineering technology has evolved. This specialization includes geological engineering technology, mining engineering technology, plastics engineering technology, and simply, materials technology.

Technologists involved with geological engineers study rocks and soils to determine the configuration and characteristics of the surface and subsurface of the earth. Technologists employed in this area analyze data and monitor the performance of excavation, soil slopes, and so forth. They engage in the analysis and interpretation of aerial photographs and data obtained through various sophisticated monitoring techniques designed to investigate the earth's crust.

Technologists working in mining engineering explore, locate, develop, and assist in mining such valuable commodities as fuels and ores, including natural gas, oil, coal, copper, gold, and silver. Some technologists working in thefield of petroleum exploration and production are called petroleum engineering technologist because of their intense specialization in the techniques of exploration for and production of natural gas and oil. Other technologists specializing in the smelting of ores and the production of metals from ores are called metallurgical engineering technologists. Ceramic engineering technologists are involved in the preparation of non-metallic products from various raw materials through the application of heat in ovens, furnaces, and kilns. Some technologists are called simply materials technologists because of their general study of materials and materials' structures and processing.

In addition to those specializing in the materials engineering technology, industrial engineering technologists specialize in the expanding field of automating manufacturing processes and achieving greater economies in the use of raw materials. This field is devoted to the development, installation, and operation of large systems involving people, machines, and raw materials. Industrial engineering technologist assist engineers in using various techniques to maximize production and minimize costs.

Other engineering technology specialty areas have developed as a result of specialization in particular areas by civil engineering technologists, or chemical engineering technologists. For example, many individuals who work closely with architects and civil engineers in the design, planning, construction, and maintenance of structures are referred to a architectural engineering technologists. This specialization has become necessary because in recent times buildings have increased greatly in size and complexity. In order to use materials and structural elements in the most efficient way to insure a safe and comfortable environment for the persons using these large complex structures, it has become necessary for engineers and architects to have the assistance of certain technologists who have concentrated their educational efforts in the areas of building design, structural design, and the design of mechanical and electrical equipment. These technologists work closely with the architects and engineers to furnish structural, air conditioning, plumbing, communications, lighting, and transportation systems in a well-integrated package in modern structures.

Another example of the intense specialization necessary on the part of some technologists is the area of aerospace engineering technology. Mechanical engineers have been interested in the development of power plants and airframes for many years, while at the same time, chemical engineers and chemical engineering technologists have been working on the development of new and better fuels. However, the utilization of fuels in space vehicles has required that a large group of engineers specialize in the field of aeronautics and aerospace engineering. Aerospace engineering technologists have assisted in the development of efficient and powerful engines for space vehicles and have cooperated with electrical engineers in the development of control systems for space vehicles and for instruments to monitor the performance of such vehicles during flight.

The growing emphasis on nuclear power as a possible source of energy has led some engineers and technologists to specialize in the generation and transmission of power obtained through nuclear reactions. Thus, the new field of nuclear engineering technology has developed. Persons engaged in this field are concerned with the design, construction, and operation of nuclear reactors. Because of the serious consequences of an accident in a nuclear power plant, a significant portion of the nuclear engineering technologist's effort will be devoted to monitoring and controlling power plant operation and maintenance. As other sources of energy become more expensive and less plentiful, emphasis on nuclear energy will increase, and the field of nuclear engineering technology will become more important.

Many other particular specialties could be identified in the bast spectrum of engineering technology. These specialties have developed as a result of concentration of effort on the part of engineers and technologists trained in more traditional fields who have responded to particular needs. It is impossible to list all of these specialties here. However, almost all of these new special interests within the field of engineering technology are outgrowths of the more traditional fields of engineering decribed in detail above. Thus, a studen seeking a career in engineering technology generally can recieve adequate preparation for work in a particular specialty area by studying in one of the more traditional areas of engineering technology listed above.

TEACHER ACTIVITIES

1. Discuss unit
2. Handout information sheet No. 1.
3. If a test is given it should be comprised of those items discussed in detail throughout the five units.

STUDENT ACTIVITIES

1. Study information sheet No. 1.
2. Take test, if given; or participate in discussion of variety of engineering areas.

REFERENCES/RESOURCES

I. References

Heer, John, and Hagerty, Joseph, Engineering Technology, Skokie, Illinois, VGM Career Horizons, 1979.

INFORMATION SHEET NO. 1

I. Electrical Engineering

As mentioned previously, electricity was first used to supply illumination and to prmit communications over long distances. However, these uses of electricity are being replaced rapidly by the use of electricity to furnish power for industrial and domestic use. A student who is interested in a career in electrical engineering technology may wish to consider working in the field of electrical power generation and transmission or in the use of electrical power in the home or in an industry. Technologists might also be involved in the development of communications systems or new and more efficient lighting systems based upon electricity and electronics.

The development of communications technology as a distinct area within electrical engineering technology has been very rapid during the last fifty years and continues at a great pace. The sequence of communications devices based upon electricity and electronics includes the telegraph, the telephone, the wireless set, the radio, motion pictures with sound, telephoto transmitters, and television. These devices have been developed and manufactured in greater complexity with more reliability and at lower costs with each succeeding year. Electrical engineering technologists can participate in the development and testing of new communication devices as well as supervision of the manufacture of already developed devices. Additionally, electrical engineering technologists specializing in communications may be involved in the generation, transmission, and reception of electro-magnetic waves through radio and television stations and other communication facilities. Thus, one of the oldest uses of electrical technology continues to be one of the most important.

In addition to the direct use of electricity to power industry and to furnish light and heat in homes, electrical phenomena are being utilized in even greater sophistication and complexity to control and monitor industrial processes, living conditions, and many other processes. Many of these sophisticated instrumentation systems are based upon electronics.

Electrical engineering technologists who are involved in electronics will assist in the design, manufacture, and use of various types of vacuum tubes and solid state electronic devices. In addition, they can assist engineers in designing and testing new electronic devices designed for communications or for instrumentation.

One of these uses for electronic devices is so important that it deserves special consideration. This is the use of electronic and electrical devices in the modern digital and analog computers. Because of the capability of performing complex operations very rapidly through the use of electronic circuits, electrical engineers and technologists have developed very small computers which are capable of performing complex calculations and computations in fractions of a second. The electrical engineering technologist is almost certain to become involved in some way in the design, manufacturer, or use of such devices if this area of activity is of interest to him. The use of microprocessors and minicomputers in this field is one of the most rapidly growing areas of technology today and promises a growing future for electrical engineering technologists.

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Technologists in chemical engineering also may be involved in the refining of such natural materials as petroleum and rubber. Petroleum is utilized as a fuel in such forms as natural gas, gasoline, kerosene, and fuel oil. The chemical engineering technologist may be involved in some way in the refining and purifying of petroleum fuels, as well as in the manufacture of chemicals from petroleum (petrochemicals). This is a growing field in which chemical engineering technologists are being employed in ever-greater numbers.

Other growing fields of manufacture and development in the chemical engineering industry include the development of biochemicals produced in nature by plants and animals. The chemical engineering technologist working in this area would be one who is interested in developing chemicals produced in nature in great quantity, at a reasonable cost, with a high degree of purity. In other words, the technologist is employed in trying to reproduce, in full-scale manufacturing plants, the biochemical processes which occur in nature.

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In addition to the fields mentioned above, other specialized areas of interest have developed in engineering technology as a result of a combination of efforts in the older branches listed above and in response to specialized needs. For example, one branch of engineering technology called materials engineering technology has evolved. This specialization includes geological engineering technology, mining engineering technology, plastics engineering technology, and simply, materials technology.

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In addition to those specializing in the materials engineering technology, industrial engineering technologists specialize in the expanding field of automating manufacturing processes and achieving greater economies in the use of raw materials. This field is devoted to the development, installation, and operation of large systems involving people, machines, and raw materials. Industrial engineering technologist assist engineers in using various techniques to maximize production and minimize costs.

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Many other particular specialties could be identified in the vast spectrum of engineering technology. These specialties have developed as a result of concentration of effort on the part of engineers and technologists trained in more traditional fields who have responded to particular needs. It is impossible to list all of these specialties here. However, almost all of these new special interests within the field of engineering technology are outgrowths of the more traditional fields of engineering decribed in detail above. Thus, a student seeking a career in engineering technology generally can recieve adequate preparation for work in a particular specialty area by studying in one of the more traditional areas of engineering technology listed above.

EQUIPMENT AND SUPPLIES

1. PENCIL AND PAPER NEEDED IF TESTED.

U.S.O.E. Career Cluster:

COMMUNICATIONS

Occupational Family:

DESIGN OCCUPATIONS (Architects)

NATURE OF WORK

Good design can improve the appearance and usefulness of the products that we use and the places where we live, and work, as well as increase sales by improving the "eye appeal". Architects design buildings that successfully combine these elements of attractiveness, safety, and usefulness. Most architects provide professional services to clients planning a building project. Attractive buildings improve the physical environment of a community. Buildings also must be safe and must allow people both inside and around them to perform their duties properly. The architect and client first discuss the purposes, requirements, and any preference in design that the client may have. Next, schematics and models may be prepared to show the scale and structural relationships of the building. The architect then prepares working drawing of the structure and specifies materials and sometimes interior furnishings.

As construction proceeds, the architect makes periodic visits to the building site to insure that the contractor is following the design, meeting the specified materials, and meeting the specified quality standards. They design a wide variety of structures such as houses, churches, hotels, hospitals, office buildings, and airports. Beside designing structures, architects also may help in selecting building sites, preparing cost and land-use studies, and long-range planning for site development.

ANALYSIS OF JOB PREREQUISITES

Persons planning careers in architecture should be able to work independently, have a capacity for solving technical problems, and be artistically inclined. They also must be prepared to work in the competitive environment of business where leadership and ability to work with others are important. New graduates usually begin as junior drafters in architectural firms where they prepare architectural drawings and make models of structures under the direction of a registered architect.

All states require architects to be licensed. To qualify for a licensing exam, a person must have either a bachelor of architecture degree followed by three years of experience in an architect's office or a master's degree of architecture followed by two years of experience.

ANALYSIS OF JOB ATTRIBUTES

Most schools offering professional degrees in architecture offer a five-year curriculum leading to a Bachelor of Architecture degree or a six-year curriculum leading to a Master of Architecture degree. Students also may transfer to professional degree programs after completing a two-year junior or community college program of architecture. A typical college architectural program includes courses in architectural theory, design, graphics, engineering, and urban planning, as well as in English, mathematics, chemistry, sociology, economics, and foreign language.

After several years of experience, architects may advance to chief or senior drafter responsible for all major details of a set of working drawings and for supervising other drafters. Others may work as designers, construction contract administrators, or specification writers. Usually, however, the architect's goal is to own his or her own business.

The average salary for architects in 1976 was well over $20,000. The range in their incomes is very wide. Some architects with many years of experience and good reputations earn well over $35,000 a year. Annual income for architects with their own firm, may fluctuate due to changing business conditions. Refer to the latest edition of Occupational Outlook Handbook for recent salary ranges.

Most architects spend long hours at the drawing board in well equipped offices. An architect sometimes has to work overtime to meet a deadline. The routine often is varied by interviewing clients or contractors and discussing the design, construction procedures, or building materials of a project with architects or engineers. Architects are expected to face competition for jobs through the mid 1980's. Although employment of architects is expected to rise about as fast as the average for all workers during this period, the number of degrees granted in architecture also has been increasing rapidly. Growing public concern about the quality of the physical environment and energy conservation is expected to increase the demand for urban redevelopment and city and community environmental planning projects.

JOB TITLES

Some job titles in the design occupations are:

Title	D.O.T.
Architect	001.061.010
Marine Architect	001.061.014
Landscape Architect	001.061.018
Industrial Designer	142.061.026
Interior Designer	142.051.014
Tool Designer	007.061.026
Graphic Designer	141.061.018
Technical Illustrator	017.281.034

SOURCES OF ADDITIONAL INFORMATION

The American Institute of Architects
1735 New York Avenue, NW
Washington, DC 20006

The Association of Collegiate Schools of Architecture, Inc.
1735 New York Avenue, NW
Washington, DC 20006

Dictionary of Occupational Titles, Fourth Edition, 1977.

Occupational Outlook Handbook, 1978-79 Edition.

Technical Education Yearbook, 1977-78 Edition.

Encyclopedia of Careers and Vocational Guidance, 1972 Edition.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

U.S.O.E. Career Cluster:

COMMUNICATIONS

Occupational Family:

ENGINEERING

NATURE OF WORK

Engineers apply the theories and principles of science and mathematics to practical technical problems. Engineers design machinery, products, systems, and processes for efficient and economical performance. They develop electric power, water supply, and waste disposal systems to meet the problems of urban living. They design industrial machinery and equipment used to manufacture goods; and heating, air conditioning, and ventilation equipment for more comfortable living. Engineers design and develop consumer products such as automobiles, television sets, and refrigerators, and systems for control and automation of manufacturing, business, and management processes. They also work in testing, production, operation, or maintenance. They supervise the operation of production processes, determine the causes of breakdowns, and perform tests on newly manufactured products to ensure that quality standards are maintained. Engineers within each of the branches may apply their specialized knowledge to many fields.

ANALYSIS OF JOB PREREQUISITES

Engineers should be able to work as part of a team and should have creativity, an analytical mind, and a capacity for detail. They should be able to express their ideas well orally and in writing. They apply the theories and principles of science and mathematics to practical technical problems.

A bachelor's degree in engineering is the generally accepted educational requirement for beginning engineering jobs. College graduates trained in one of the natural sciences or mathematics also may qualify for some beginning jobs. Graduate training is being emphasized for an increasing number of jobs; it is essential for most beginning teaching and research positions, and is desirable for advancement.

All the states and the District of Columbia now have license for professional engineers under state laws. These laws generally require graduation from an accredited engineering college and minimum of four years of responsible engineering experience and passing an examination administered by examining board.

ANALYSIS OF JOB ATTRIBUTES

Some engineering curriculums require more than four years to complete. A number of colleges and universities now offer five-year master's degree programs. Some schools have five-or-six year cooperative plans where students coordinate classroom study and practical work experience. In addition to gaining useful experience, students can finance part of their education. Because of the need to keep up with the rapid advances in technology, engineers often continue their education throughout their careers. Engineering graduates usually begin work under the supervision of experienced engineers.

Many engineers work indoors in offices and research laboratories. Others, however, spend time in more active work—in a factory or mine, at a construction site, or some other outdoor location.

Experienced engineers may advance to position of greater responsibility and some engineers move to management or administrative positions after several years of engineering. Some engineers obtain graduate degrees in business administration to improve their advancement opportunities. While still others obtain law degrees and become patent attorneys.

Employment opportunities for engineers are expected to be good through the mid 1980's in most specialties. More engineers will be needed in the design and construction of factories, utility systems, office buildings, and transportation systems. Engineers will be required in energy related activities developing sources of energy as well as designing energy-saving systems for automobiles, homes, and other buildings.

Engineering graduates with a bachelor's degree and no experience were offered average starting salaries of $14,800 a year in private industry in 1976; those with a master's degree and no experience almost $16,000 a year; and those with Ph.D. over $21,000. Refer to the latest edition of Occupational Outlook Handbook for recent salary ranges.

JOB TITLES

Some job titles in the engineering occupations are:

Title	D.O.T.
Aeronautical Engineer	002.061.014
Agricultural Engineer	013.061.010
Chemical Engineer	008.061.018
Civil Engineer	005.061.014
Electrical Engineer	003.061.010
Electronics Engineer	003.061.030
Factory Lay-out Engineer	012.167.018
Industrial Engineer	012.167.030
Mechanical Engineer	007.061.014
Safety Engineer	012.061.014
Structural Engineer	005.061.038

SOURCES OF ADDITIONAL INFORMATION

Engineers' Council for Professional Development
345 E. 47th Street
New York, N.Y. 10017

Engineering Manpower Commission of Engineers Joint Council
345 E. 47th Street
New York, N.Y. 10017

National Society of Professional Engineers
2029 K Street NW
Washington, D.C. 20006

Dictionary of Occupational Titles, Fourth Edition, 1977.

Occupational Outlook Handbook, 1978-79 Edition.

Technical Education Yearbook, 1977-78 Edition.

Encyclopedia of Careers and Vocational Guidance, 1972 Edition.

Beakley, George and Leach, H.W., *Career in Engineering and Technology*. London: The MacMillan Company, 1969.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

U.S.O.E. Career Cluster:

COMMUNICATIONS

Occupational Family:

ENGINEERING TECHNOLOGY

NATURE OF WORK

Technicians often supply the theoretical knowledge developed by engineers and scientists to actual situations. They frequently use complex electronics and mechanical instruments, experimental laboratory equipment, and drafting instruments. Almost all technicians in this family must be able to use technical handbooks and computing devices such as slide rules and calculating machines. In research and development, one of the largest areas of employment, technicians set up experiments and calculate the results using complex instruments. They also assist engineers and scientists in developing experimental equipment and models by making drawing and sketches and, frequently, by doing routine design work. In production, technicians usually follow the plans and general directions of engineers and scientists, but often without close supervision. Engineering technicians are classified according to the areas in which they work.

ANALYSIS OF JOB PREREQUISITES

Knowledge of science, mathematics, industrial machinery, and technical processes enables engineering and science technicians to work in all phases of business and government, from research and design to manufacturing, sales, and customer service.

Interested students should have an aptitude for mathematics and science and enjoy technical work. An ability to do detailed work with a high degree of accuracy is necessary; for design work, creative talent is also necessary.

Specialized training is available at technical institutes, junior and community colleges, area vocational-technical schools, extension divisions of colleges and universities, and vocational technical high schools. Some engineering and science students who have not completed the bachelor's degree and other who have degrees in science and mathematics also are able to qualify for technicians' positions. Workers may also learn through on-the-job training, apprenticeship programs, or correspondence schools. Some qualify on the basis of experience gained in the Armed Forces. However, post secondary training is becoming increasingly necessary for advancement to more responsible jobs.

ANALYSIS OF JOB ATTRIBUTES

Technicians sometimes must work under the close supervision of engineers as well as with other technicians and skilled workers. As they gain experience, they receive more responsibility and may move into supervisory positions. Those who have the ability and obtain additional education sometimes are promoted to positions as scientists or engineers.

Employment opportunities for engineering and science technicians are expected to be favorable through the mid-1980's. Opportunities will be best for graduates of postsecondary school technicians training programs. Industrial expansion and the increasing complexity of modern technology underlie the anticipated increase in demand for technicians. The anticipated growth of research and development expenditures in industry and government should increase requirements for technicians. The outlook for technicians is based on the assumption that defense spending will increase from the 1976 level by the mid-1980's. If defense spending should differ substantially from this level, the demand for technicians would be affected accordingly.

In private industry in 1976, average starting salaries for two-year graduates ranged from about $9,000 to $10,800 a year, while those who did not complete a two-year program earned average starting salaries from just over $6,400 to about $9,300. Senior engineering technicians in private industry earned average salaries of about $16,000 a year. The average annual salary for all engineering technicians employed by the Federal Government in 1977 was $17,800. Refer to the latest edition of Occupational Outlook Handbook for recent salary ranges.

JOB TITLES

Some job titles in the engineering occupations are:

Title	D.O.T.
Chemical Engineering Technician	008.261.010
Electrical Technician	003.161.010
Electronics Technician	003.161.014
Mechanical Engineering Technician	007.161.026

SOURCES OF ADDITIONAL INFORMATION

Engineers Council for Professional Development
345 East 47th Street
New York, NY 10017

National Association of Trade and Technical Schools
Accrediting Commission
2021 L Street NW
Washington, DC 20036

U.S. Department of Health, Education, and Welfare
Office of Education
Washington, DC 20202

American Association of Community and Junior Colleges
Suite 410, 1 Dupont Circle
Washington, DC 20036

National Home Study Council
1601 18th Street NW
Washington, DC 20009

Dictionary of Occupational Titles, Fourth Edition, 1977.

Occupational Outlook Handbook, 1978-79 Edition.

Technical Education Yearbook, 1977-78 Edition.

Encyclopedia of Careers and Vocational Guidance, 1972 Edition.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

U.S.O.E. Career Cluster:

COMMUNICATIONS

Occupational Family:

DRAFTING

NATURE OF WORK

Drafters prepare detailed drawings based on rough sketches, specification, and calculations made by scientists, engineers, architects, and designers. They also calculate the strength, quality, quantity, and cost of materials. Final drawing contains a detailed view of the object from all sides as well as specifications for materials to be used, procedures followed, and other information to carry out the job. Drafters are classified according to the work they do or their level of responsibility.

In preparing drawings, drafters use compasses, dividers, protractors, triangles, and other drafting devices. They also use engineering handbooks, tables, and calculators to help solve technical problems.

ANALYSIS OF JOB PREREQUISITES

Training for a career in drafting whether in a high school or post-high school program, should include courses in mathematics, physical sciences, mechanical drawing, and drafting. Shop practices and shop skills are also helpful since many higher drafting jobs require knowledge of manufacturing or construction methods.

Those planning careers in drafting should be able to do freehand drawings of three-dimensional objects and also detailed work requiring a high degree of accuracy. They should also have good eyesight and manual dexterity. In addition, they should be able to function as part of a team since they work directly with engineers, architects, and skilled workers. Artistic ability is helpful in specialized fields.

ANALYSIS OF JOB ATTRIBUTES

Prospective drafters can acquire the necessary training in technical institutes, junior and community colleges, extension divisions of universities, and vocational and technical high schools. Some persons receive training and experience in the Armed Forces. Others quality through on-the-job training programs combined with part-time school or three to four years apprenticeship programs. Many technical schools offer courses in structural design, architectural drawing, and engineering or industrial technology.

High school graduates usually start as tracers. Those having post high school technical training may begin as junior drafters. After gaining experience, they may advance to checkers, detailers, senior drafters, or supervisors. Courses in engineering and mathematics sometimes enable drafters to transfer to engineering positions.

Employment of drafters, both male and female is expected to increase faster than the average for all occupations. This growth along with the need to replace those who die, retire, or move into other fields of work, should provide favorable job opportunities through the mid-1980's.

Although drafters usually work in well-lighted and well-ventilated rooms, they often must sit for long periods of time doing detailed work. Occasionally, drafters may visit other offices or construction sites to gain first-hand information about a certain assignment.

In private industry, tracers averaged about $8,400 a year in 1976, while more experienced drafters averaged between $9,800 and $12,000 a year. In 1977, the Federal Government paid drafters having an associate degree starting salaries of $8,316 a year. Those with less education or experience generally started at $7,408. The average Federal Government salary for all drafters was about $11,000 a year. Refer to the latest edition of Occupational Outlook Handbook for recent salaries.

JOB TITLES

Job titles in this occupational family are:

Title	D.O.T.
Aeronautical Drafter	002.261.010
Architectural Drafter	001.261.010
Automotive Design Drafter	017.281.026
Civil Drafter	005.281.010
Commercial Drafter	017.261.026
Directional Survey Drafter	010.281.010
Electrical Drafter	003.281.010
Electronic Drafter	003.281.014
Electromechanisms Design Drafter	017.261.014
Geological Drafter	010.281.014
Geophysical Drafter	010.281.018

Title	D.O.T.
Heating and Ventilating Drafter	017.261.034
Landscape Drafter	001.261.014
Mechanical Drafter	007.281.010
Oil and Gas Drafter	017.281.030
Plumbing Drafter	017.261.038
Structural Drafter	005.281.014
Tool Design Drafter	007.261.022
Topographical Drafter	018.261.014
Assistant Drafter	017.281.018

JOB STRUCTURE: DRAFTING

JOB TITLE: Drafter D.O.T.

Major Job Function:

Prepares clear, complete, and accurate working plans and detail drawings from rough or detailed sketches or notes for engineering or manufacturing purposes, according to specified dimensions.

Job Duties:

1. Makes final sketch of proposed drawing, checking dimension of parts, materials to be used, relation of one part to another, and relation of various parts to whole structure or project.
2. Makes any adjustments or changes necessary or desired.
3. Inks in lines and letters on pencil drawings as required.
4. Exercises manual skill in manipulation of triangles, T-Square, and other drawing tools.
5. Draws charts for representation of statistical data.
6. Draws finished designs from sketches.
7. Utilizes knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete drawings. CLASSIFICATIONS ARE MADE ACCORDING TO TYPE OF DRAFTING.

JOB TITLE: Aeronautical Drafter D.O.T. No.:

Major Job Functions:

Performs duties of Drafter specializing in drafting engineering drawings of developmental or production airplanes and missiles ancillary equipment, including launch mechanisms and scale models of prototype aircraft, as planned by Aeronautical Engineer.

JOB TITLE: Architectural Drafter D.O.T. No.: 001 261 010

Major Job Function:

Performs duties of DRAFTER by drawing artistic and structural features of any class of buildings and like structures.

Job Duties:

1. Delineates designs and details, using drawing instruments.
2. Confirms compliance with building codes.
3. May specialize in planning architectural details according to structural materials used as Drafter, Tile and Marble.

JOB TITLE: Landscape Drafter D.O.T. No.: 001 261 014

Major Job Function:

Prepares detailed scale drawings and tracings from rough sketches or other data provided by Landscape Architect performing duties described under Drafter.

Job Duties:

1. May prepare separate detailed site plan, grading and drainage plan, lighting plan, paving plan, irrigation plan, planting plan, and drawings and detail of garden structures.
2. May build models of proposed landscape construction and prepare colored drawings for presentation to client.

JOB TITLE: Electrical Drafter D.O.T. No.: 003 281 010

Major Job Function:

Drafts electrical equipment working drawings and wiring diagrams used by construction crews and repairmen who erect, install, and repair electrical equipment and wiring in communications centers, power plants, industrial establishments, commercial or domestic buildings, or electrical distribution systems, performing duties as described under Drafter.

JOB TITLE: Electronic Drafter D.O.T. No.: 003 281 014

Major Job Function:

Drafts wiring diagrams, schematics, and layout drawings used in manufacture, assembly, installation, and repair of electronic equipment, such as televsion cameras, radio transmitters and receivers, audioamplifiers, computers, and radiation defectors, performing duties as described under Drafter.

Job Duties:

1. Drafts layout and detail drawings of racks, panels, and enclosures.

2. May conduct service and interferences studies and prepare maps and charts related to radio and television surveys.

JOB TITLE: Civil Drafter D.O.T. No.: 005 281 010

Major Job Function:

Drafts detailed construction drawings, topographical profiles, and related maps and specification sheets used in planning and construction of highways, river and harbor improvements, floor control, drainage, and other civil engineering projects, performing duties as described under Drafter.

Job Duties:

1. Plots maps and charts showing profiles and cross-sections, indicating relation of topographical contours and elevations to buildings, retaining walls, tunnels, overhead powerlines, and other structures.

2. Drafts detailed drawings of structures and installations such as roads, culverts, fresh water supply and sewage disposal systems, dikes, wharfs, and breakwaters.

3. Computes volume of tonnage of excavations and fills and prepares graphs and hauling diagrams used in earthmoving operations.

JOB TITLE: Structural Drafter D.O.T. No.: 005 281 014

Major Job Functions:

Performs duties of Drafter by drawing plans and details for structures employing structural reinforcing steel, concrete, masonry, wood, and other structural materials.

Job Duties:

1. Produces plans and details of foundations, building frame, floor and roof framing and other structural elements.

JOB TITLE: Tool-Drawing Checker D.O.T. No.: 007 167 022

Major Job Function:

Examines airplane tool drawings made by Tool Designer for inaccuracies of detail and to determine production feasibility of designs.

Job Duties:

1. Visually compares design of jig, fixture, or tool with drawing of airplane parts, matching coordinating points for accuracy of fit.
2. Examines drawing details, such as dimensions, angles, allowances, and shop notes for errors, guided by specifications on engineering drawing and knowledge of mathematics and drafting.
3. Verifies size and quantity of materials and methods of fabrication.
4. Notes corrections on drawings in pencil or ink.

JOB TITLE: Chief Drafter D.O.T. No.: 007 261 010

Major Job Function:

Draws rough layout and sketches, and assigns work to and directs subordinate drafting workers.

Job Duties:

1. Sketches layout according to design proposal and standard specifications and practices.
2. Assigns drafting of detail drawings to subordinate personnel and verifies accuracy and completeness of finished drawings.
3. May perform duties described under Drafter.

JOB TITLE: Tool Design Drafter D.O.T. No.: 007 261 022

Major Job Function:

Drafts detailed drawing plans for manufacture of tools, usually following designs and specifications indicated by Tool Designer.

Job Duties:

1. Performs duties as described under Drafter.

JOB TITLE: Directional Survey Drafter D.O.T. No.: 010 281 010

Major Job Function:

Plots oil or gas-well boreholes from photographic subsurface survey recordings and other data.

Job Duties:

1. Computes and represents diameter, depth, degree, and direction of inclination, location and equipment, and other dimensions and characteristics of borehole.
2. Performs other duties as described under Drafter.

JOB TITLE: Geological Drafter D.O.T. No.: 010 281 014

Major Job Function:

Draws maps, diagrams, profiles, cross sections, directional surveys, and subsurface formations to represent geological and geophysical stratigraphy and locations of gas and oil deposits, performing duties as described under Drafter.

Job Duties:

1. Correlates and interprets data obtained from topographical surveys, well logs or geophysical prospecting reports, utilizing special symbols to denote geological and geophysical formations or oilfield installations.
2. May finish drawings in mediums and according to specifications required for reproduction by blueprinting, photographing, or other duplication methods.

JOB TITLE: Geophysical Drafter D.O.T. No.: 010 281 018

Major Job Function:

Draws subsurface contours in rock formations from data obtained by geophysical prospecting party.

Job Duties:

1. Plots maps and diagrams from computations based on recordings of seismograph, gravity meter, magnetometer, and other petroleum prospecting instruments and from prospecting and surveying field notes.
2. Performs other duties as described under Drafter.

JOB TITLE: Electromechanisms Design Drafter D.O.T. No.: 017 261 014

Major Job Function:

Drafts designs and electromechanical equipment such as aircraft engines, subassemblies, electronic optical-character-recognition and related data processing systems, gryoscopes, rocket engine control systems, automatic materials handling and processing machinery, or bio-medical equipment.

Job Duties:

1. Confers with engineers and other drafters to interpret design concepts, determine nature and type of required detail working drawings, and coordinate work with others.
2. Drafts details and assembly drawings performing duties described under Drafter.

JOB TITLE: Detailer D.O.T. No.: 017 261 018

Major Job Function:

Drafts detailed drawings of parts of machines or structures from rough or general design drawings.

Job Duties:

1. Shows dimensions, materials to be used, and other information necessary to make detailed drawings clear and complete.
2. Makes tracings of finished drawing on semitransparent paper from which blueprints can be made.
3. Performs other duties as described under Drafter.

JOB TITLE: Commercial Drafter D.O.T. No.: 017 261 026

Major Job Function:

Performs duties of Drafter in all-round drafting, such as laying out location of buildings, planning of arrangements in offices, large rooms, store buildings, and factories, and drawing of charts, forms, and records.

Job Duties:

1. Paints and washes colored drawings when required.

JOB TITLE: Heating and Ventilating Drafter D.O.T. No.: 017 261 034

Major Job Function:

Performs duties of Drafter, but specialized in drawing plans of installation of heating, air-conditioning, and ventilating equipment.

Job Duties:

1. May calculate heat loss and heat gain for buildings for use in determining equipment specifications, using slide rule and following standardized procedures.

2. May specialize in drawing plans for installation of refrigeration equipment as Refrigeration Drafter.

JOB TITLE: Plumbing Drafter D.O.T. No.: 017 261 038

Major Job Function:

Performs duties of Drafter but specializes in drawing of plans for installation of plumbing equipment.

JOB TITLE: Assistant Drafter D.O.T. No.: 017 281 018

Major Job Function:

Copies plans and drawings prepared by Drafter tracing them with ink and pencil on transparent paper or cloth spread over drawings, using triangle, T-Square, compass, pens, and other drafting instruments.

Job Duties:

1. Makes simple sketches or drawings under close supervision.

JOB TITLE: Automotive Design Lay-Out Drafter D.O.T. No.: 017 281 026

Major Job Function:

Prepares working layouts and master drawings of automotive vehicle components, assemblies or systems from specifications, prior layouts, well-defined sketches, models for detailing, applying knowledge of drafting techniques and procedures, automotive vehicle design, manufacturing processes and limitations, using drafting instruments and work aids.

Job Duties:

1. Studies specifications, sketches, notes and other design data and measures prior layouts, using scales and dividers, to determine details and dimensions of components being layed out from the superimposed views and sections of parts on layouts.
2. Develops design of details not completely defined.
3. Projects sections and auxiliary views of components on layouts.
4. May direct activities of detailers.

JOB TITLE: Oil and Gas Drafter D.O.T. No.: 017 281 030

Major Job Function:

Drafts plans and drawings for layout, construction, and operation of oil fields, refineries, and pipeline systems from field notes, rough or detailed sketches, and specifications.

Job Duties:

1. Develops detail drawings for construction of equipment and structures, such as drilling derricks, compressor stations, gasoline plants, frame, steel, and masonry buildings, piping manifolds and pipeline systems, and for manufacture, fabrication, and assembly of machines and machine parts.
2. Prepares maps of pipeline systems and oil and gas locations, using field survey notes and aerial photographs.

JOB TITLE: Land Surveyor D.O.T. No.: 018 167 018

Major Job Function:

Plans, organizes, and directs work of one or more survey parties engaged in surveying earth's surface to determine precise location and measurements of points, elevations, lines, areas, and contours for construction, mapmaking, land division, titles, mining or other purposes.

Job Duties:

1. Researches previous survey evidence, maps, deeds, physical evidence, and other records to obtain data needed for surveys.
2. Develops new data from photogrammetric records.
3. Determines methods and procedures for establishing or re-establishing survey control.
4. Keeps accurate notes, records and sketches to describe and certify work performed.
5. Coordinates findings with work of engineering and architectural personnel, clients, and others concerned with project.
6. Assumes legal responsibility for work and is licensed by State.

JOB TITLE: Topographical Drafter D.O.T. No.: 018 261 014

Major Job Function:

Draws and corrects topographical maps from source data, such as surveying notes, aerial photographs, or other maps.

Job Duties:

1. Performs other duties as described under Drafter.
2. May accompany survey crew in field to compile original survey data or establish location of natural or constructed landmarks.

JOB TITLE: Specification Writer D.O.T. No.: 019 267 010

Major Job Function:

Interprets architectural or engineering plans and prepares material lists and specifications to be used as standards by plant employees or contracting personnel in material processing or in manufacturing or construction activities.

Job Duties:

1. Analyzes plans and diagrams, or observes and takes notes on material processing, to determine material and material processing specifications, or specification for manufacturing or construction activities.

2. Writes technical descriptions specifying material qualities and properties, utilizing knowledge of material standards, industrial processes, and manufacturing procedures.

3. Workers usually specialize and are designated according to engineering specialization, product, or process.

JOB TITLE: Industrial Arts Teacher D.O.T. No.: 091 221 010

Major Job Function:

Teaches students basic theory and assists in development of manipulative skills in industrial arts.

Job Duties:

1. Lectures, illustrates, or demonstrates to teach proper use of shop tools and machines, safety practices, and theory as applied to industrial arts.

2. Teachers specialize in one or more areas, such as woodworking or metalworking, electricity, graphic arts, or mechanical drawing.

JOB TITLE: Vocational Training Teacher (Drafting) D.O.T. No.: 097 227 014

Major Job Function:

Teaches vocational training subjects in specific trades to students in public or private schools or in industrial plants.

Job Duties:

1. Organizes program of practical and technical instruction, involving demonstrations of skills required in trade, and lectures on theory, practices, methods, processes, and terminology.
2. Instructs students in subject areas, such as safety, mathematics, science, drawing, use and maintenance of tools and equipment, and codes or regulations related to trade.
3. Plans and supervises work of students in shop or laboratory.
4. Tests and evaluates achievement of student in technical knowledge and trade skills.

JOB TITLE: Estimator D.O.T. No.: 160 267 018

Major Job Function:

Prepares cost estimates for manufacturing of products, construction projects, or services requested to aid management in bidding on or determining price of product or service.

Job Duties:

1. Compiles list of type of materials, tool or fixture, or equipment requirements, utilizing knowledge of products to be manufactured, services to be performed, or type of structure to be built, using blueprints and specifications.
2. Itemizes tools, fixtures, or equipment to be manufactured by company or purchased from outside sources.
3. Computes cost estimates for materials, purchased equipment, subcontracted work, production activities and requirements, and labor.

JOB TTLE: Contractor D.O.T. No.: 182 167 010

Major Job Function:

Contracts to perform specified construction work in accordance with architect's plans, blueprints, codes, and other specifications.

Job Duties:

1. Estimates costs of materials, labor, and use of equipment required to fulfill provisions of contract and prepares bids.
2. Confers with clients to negotiate terms of contract.
3. Subcontracts specialized craft work, such as electrical structural steel, concrete, and plumbing.
4. Purchases material for construction.
5. Supervises workers directly or through subordinate supervisors.
6. May be designated according to specialty license or scope of principal activities.

JOB TITLE: Blueprint Trimmer D.O.T. No.: 920 687 038

Major Job Function:

Cuts blueprints, measures print margins, punches holes in prints, and folds, staples, and labels blueprints for shipment.

Job Duties:

1. Cuts individual print from continuous strip of processed prints, using shears.
2. Verifies dimensions of blueprint margins, using ruler, and cuts off excess, using shears.
3. Punches holes in blueprint, using paper punch, and folds prints.
4. Staples specified number of prints to folded edges of wrapping paper to form bound set.
5. Writes name and address of customer on wrapping.
6. May sort prints according to numerical code and examine blueprints for defects, such as clarity and double image.

JOB TITLE: Blueprinting and Photocopy Supervisor D.O.T. No.: 979 130 010

Major Job Function:

Supervises and coordinates activities of Blueprinting-Machine Operator, Photostat Operator, File Clerk and other workers engaged in producing and filing blueprints, vandyke and ozalid prints, and photostats in an industrial plant or commercial photocopy laboratory.

Job Duties:

1. Sets up blueprint and photostat machines.
2. Trains workers in operation of machines.
3. Inspects finished prints for sharpness, density of line, and size.
4. Consults with customers concerning work details, such as sizes of prints and prices.

JOB TITLE: Blueprint Machine Operator D.O.T. No.: 979 682 014

Major Job Function:

Operates machine to make copies (blueprints) of printed material, such as documents or drawings.

Job Duties:

1. Examines negative of original for translucency.
2. Selects sensitized paper according to color of line specified and positions original over paper.
3. Moves controls to regulate light intensity and exposure time, according to translucency of original and type of sensitized paper.
4. Slides original and sensitized paper into printer to expose and develop print.
5. Examines finished print for specified color, intensity, and sharpness of line.
6. Pushes button to supply machine with ammonia or manually pours ammonia into printer.

JOB STRUCTURE: DESIGN

JOB TITLE: Architect D.O.T. No.: 001 061 010

Major Job Function:

Provides professional services in research, development, design, construction, alteration, or repair of real property, such as private residences, office buildings, theaters, public buildings, or factories.

Job Duties:

1. Consults with client to determine functional and spatial requirements and prepares information regarding design, specifications, materials, equipment, estimated costs, and building time.
2. Plans layout of project and integrates engineering elements into unified design.
3. Prepares scale and full size drawings and contract documents for building contracts.
4. Assists client in obtaining bids and awarding construction contracts.
5. Supervises administration and construction contracts and conducts periodic on-site observation of work in progress.

JOB TITLE: Marine Architect D.O.T. No.: 001 061 014

Major Job Function:

Designs and oversees construction and repair of marine craft and floating structures, such as ships, barges, tugs, dredges, submarines, torpedos, floats, and buoys.

Job Duties:

1. Studies design proposals and specifications to establish basic characteristics of craft, such as size, weight, speed, propulsion, arnament, cargo, displacement, draft, crew and passenger complements, and fresh and salt water service.

2. Oversees construction and testing.

3. Designs complete hull and superstructure according to specifications and test data, in conformity with standards of safety, efficiency, and economy.

4. Designs layout of craft interior including cargo space, passenger compartments, ladder wells and elevators.

JOB TITLE: Tool Designer D.O.T. No.: 007 061 026

Major Job Function:

Designs broaches, milling-machine cutters, drills and other single- or multiple-edged cutting tools, and related jigs, dies, and fixtures for production or experimental use in metalworking machines.

Job Duties:

1. Studies specifications and confers with engineering and shop personnel to resolve design problems related to material characteristics, dimensional tolerances, service requirements, manufacturing procedures and cost of tools.

2. Applies algebraic and geometric formulas and standard tool engineering data to develop tool configuration.

3. Selects standard items such as bushings and tool bits for incorporation into tool design.

4. Draws preliminary sketches and prepares layout and detail drawings.

5. Modifies tool designs according to trial and production service data to improve tool life or performance.

JOB TITLE: Technical Illustrator D.O.T. No.: 017 281 034

Major Job Function:

Lays out and draws illustrations for reproduction in reference works, brochures, and technical manuals dealing with assembly, installation, operation, maintenance, and repair of machines, tools, and equipment.

Job Duties:

1. Prepares drawings from blueprints, designs, mockups, and photoprints by methods and techniques suited to specified reproduction process or final use, such as blueprint, photo-offset, and projection transparencies, using drafting and optical equipment.
2. Lays out and draws schematic, perspective, orthographic, or oblique-angle views to depict function, relationship, and assembly-sequence of parts and assemblies, such as gears, engines, and instruments.
3. Shades or colors drawing to emphasize details or eliminate undesired background using ink, crayon, airbrush, and overlays.
4. Pastes instructions and comments in position on drawing.

JOB TITLE: Graphic Designer D.O.T. No.: 141 061 018

Major Job Function:

Designs art and copy layouts for material to be presented by visual communications media, such as books, magazines, newspapers, television, and packaging.

Job Duties:

1. Studies illustrations and photographs to plan presentation of material, product, or service.
2. Determines size and arrangement of illustrative material and copy, selects style and size of type, and arranges layout based upon available space, knowledge of layout principles, and esthetic design concepts.

Graphic Designer Job Duties (continued):

3. Draws sample of finished layout and presents to ART DIRECTOR for approval.

4. Prepares notes and instructions for workers who assemble and prepare final layouts for printing.

5. Reviews final layout and suggests improvements as needed.

JOB TITLE: Interior Design D.O.T. No.: 142 051 014

Major Job Function:

Plans, designs, and furnishes interior environments of residential, commercial, and industrial buildings.

Job Duties:

1. Advises client on interior design factors, such as space planning, layout and utilization of furnishings and equipment, color schemes, and color coordination.

2. Renders design ideas in form of paste ups, drawings, or illustrations, estimates material requirements and costs, and presents design to client for approval.

3. Selects or designs and purchases furnishings, art works, and accessories.

4. May plan and design interior environments for boats, planes, buses, trains, and other enclosed spaces.

5. May be designated Interior Decorator.

JOB TITLE: Industrial Designer D.O.T. No.: 142 061 026

Major Job Function:

Originates and develops ideas to design the form of manufactured products.

Job Duties:

1. Reads publications; attends showings, and consults with engineering, marketing, production, and sales representatives to establish design concepts.

2. Evaluates design ideas based on factors such as appealing appearance, design-function relationships, serviceability, materials and methods engineering, application, budget, price, production costs, method of production, market characteristics, and client specifications.

3. Presents design to client or design committee and discusses need for modification and change.

4. Usually specializes in specific product or type of product including, but not limited to hardware, motor vehicle exteriors and interiors, scientific instruments, industrial equipment, luggage, jewelry, houseware, toys, or novelties and is designated accordingly.

JOB STRUCTURE: ENGINEERING TECHNOLOGY

JOB TITLE: Technicians D.O.T. No.: Profess

Major Job Function:

A term applied to a worker who works in direct support to Engineers or Scientist, utilizing theoretical knowledge of fundamental scientific, engineering, mathematical, or draft design principles.

Job Duties:

1. Solves practical problems encountered in fields of specialization, such as those concerned with development of electrical and electronic circuits, and establishment of testing methods for electrical, electronic, electromechanical, and hydromechanical devices and mechanisms, application of engineering principles in solving design, development, and modification problems of parts or assemblies for products or systems; and application of natural and physical science principles to basic or applied research problems in fields, such as metallurgy, chemistry, and physics.
2. Classifications are made according to specialization.

JOB TITLE: Electrical Technician D.O.T. No.: 003 161 010

Major Job Function:

Applies electrical theory and related knowledge to test and modify developmental or operational electrical machinery and electrical control equipment and circuitry in industrial or commercial plants and laboratories.

Job Duties:

1. Assembles and test experimental motor-control devices, switch panels, transformers, generator windings, solenoids, and other electrical equipment and components according to engineering data and knowledge of electrical principles.

Electrical Technician Job Duties (continued):

2. Modifies electrical prototypes to correct functional deviations under direction of Electrical Engineer.

3. Diagnoses cause of electrical or mechanical malfunction of failure of operational equipment and performs preventive and corrective maintenance.

4. Develops wiring diagrams, layout drawings, and engineering specifications for system or equipment modifications or expansion, and directs personnel performing routine installation and maintenance duties.

5. Plans, directs, and records periodic testing, and recommends or initiates modification or replacement of equipment which fails to meet acceptable operating standards.

JOB TITLE: Electronics Technician D.O.T. No.: 003 161 014

Major Job Function:

Applies electronic theory principles of electrical circuits, electrical testing procedures, engineering mathematics, physics, and related knowledge to layout, build, test, troubleshoot, repair, and modify developmental and production electronic equipment.

Job Duties:

1. Discusses layout and assembly problems with Electronics Engineer and draws sketches to clarify design details and functional criteria of electronic units.

2. Assembles experimental circuitry or complete prototype model according to engineering instructions, technical manuals, and knowledge of electronic systems and components and their functions.

3. Adjusts, calibrates, aligns, and modifies circuitry and components and records effects on unit performance.

4. Writes technical reports and develops charts, graphs, and schematics to describe and illustrate systems operating characteristics, malfunctions, deviations, from design specifications.

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JOB TITLE: Chemical Engineering Technician **D.O.T. No.:** 008 261 010

Major Job Function:

Applies chemical engineering principles and technical skills to assist Chemical Engineer in developing, improving and testing chemical-plant processes, products, and equipment.

Job Duties:

1. Prepares charts, sketches, diagrams, flow charts, and compiles and records engineering data to clarify design details or functional criteria of chemical processing and physical operation units.
2. Participates in fabricating, installing, and modifying equipment to insure that critical standards are met.
3. Test developmental equipment and formulates standard operating procedures.
4. Tests processing equipment and instruments to observe and record operating characteristics and performance of specified design and process.
5. Observes chemical or physical operation processes and recommends modification or change.
6. Writes technical reports and submits findings to Chemical Engineer.

JOB STRUCTURE: ENGINEERING

JOB TITLE: Aeronautical Engineer D.O.T. No.: 002 061 014

Major Job Function:

Designs, develops, and tests aircraft, space vehicles, surface effect vehicles, and missiles, applying engineering principles and techniques.

Job Duties:

1. Designs and develops commercial, military, executive, general aviation or special purpose aircraft, space vehicles, satellites, missiles, scientific probes; or other related hardware or systems.
2. Test models, prototypes, subassemblies, or production vehicles to study and evaluate operational characteristics and effects of stress imposed during actual or simulated flight conditions.
3. May specialize in design and development of structural components, such as wings, fuselage, rib assemblies, landing gear, or operational control systems.

JOB TITLE: Electrical Engineer D.O.T. No.: 003 061 010

Major Job Function:

Conducts research and development activities concerned with design, manufacture, and testing of electrical components, equipment, and systems; applications of equipment to new uses; and manufacture, construction, and installation of electrical equipment, facilities, and systems.

Job Duties:

1. Designs electrical components of equipment, and equipment used in generation of electric power or products and systems utilizing electrical energy for commercial, domestic, and industrial purposes.

Electrical Engineer Job Duties (continued):

2. Develops applications of controls, instruments, and systems to new commercial, domestic, and industrial uses.

3. Directs activities concerned with manufacture, construction, installation, and operational testing to insure conformance of equipment and systems with functional specifications and customer requirements.

JOB TITLE: Electronics Engineer D.O.T. No.: 003 061 030

Major Job Function:

Conducts research and development activities concerned with design, manufacture, and testing of electronic components, products, and systems, and in development of applications of products to commercial, industrial, medical, military, and scientific uses.

Job Duties:

1. Designs electrical circuits, electronic components, and integrated systems, using ferroelectric, nonlinear, dielectric, phosphor, photoconductive, and thermoelectric properties of materials.

2. Develops new applications of electrical and dielectric properties of metallic and non-metallic materials used in components, and in application of components to products or systems.

JOB TITLE Civil Engineer D.O.T. No.: 005 061 014

Major Job Function:

Plans, designs, and directs construction and maintenance of structures and facilities, such as roads, railroads, airports, bridges, harbors, channels, dams, irrigation projects, pipelines, powerplants, water and sewage systems, and waste disposal units.

Job Duties:

1. May perform exclusively in environmental engineering specialty as described under Environmental Engineer.

Civil Engineer Job Duties (continued):

2. May perform technical research and utilize computers as aids in developing solutions to engineering problems.

3. May be designated according to specialty or product.

JOB TITLE: Structural Engineer D.O.T. No.: 005 061 038

Major Job Function:

Directs or participates in planning, designing, or reviewing plans for erection of structures requiring stress analysis.

Job Duties:

1. Designs structure to meet estimated load requirements, computing size, shape, strength, and type of structural members, or performs structural analysis of plans and structures prepared by private engineers.

2. May inspect existing projects and recommend repair and replacement of defective members or rebuilding of entire structure.

JOB TITLE: Chemical Engineer D.O.T. No.: 008 061 018

Major Job Function:

Designs equipment and develops processes for manufacturing chemicals and related products utilizing principles and technology of chemistry, physics, mathematics, engineering and related physical and natural sciences.

Job Duties:

1. Conducts research to develop new and improved chemical manufacturing processes.

2. Designs, plans layout, and oversees workers engaged in constructing, controlling, and improving equipment to carry out chemical processes on commercial scale.

Chemical Engineer Job Duties (continued):

3. Analyzes operating procedures and equipment and machinery functions to reduce processing time and cost.

4. Designs equipment to control movement, storage, and packaging of solids, liquids, and gases.

5. Designs and plans measurement and control systems for chemical plants based on data collected in laboratory experiments and pilot plant operations.

6. May apply principles of chemical engineering to solve environmental problems.

JOB TITLE: Safety Engineer D.O.T. No.: 012 061 014

Major Job Function:

Develops and implements safety program to prevent or correct unsafe environmental working conditions, utilizing knowledge of industrial processes, mechanics, chemistry, psychology, and industrial processes, mechanics, chemistry, psychology, and industrial health and safety laws.

Job Duties:

1. Examines plans and specifications for new machinery and equipment to ascertain if all safety precautions have been included.

2. Determines amount of weight that can be placed on plant floor with safety.

3. Inspects machinery to determine places where danger of injury exists.

4. Designs, builds, and installs, or directs installation of guards on machinery, belts, and conveyors.

5. Inspects premises for fire hazards and adequacy of fire protection and inspects firefighting equipment.

6. Studies each accident to minimize recurrence.

7. Educate workers to dangers existing in plant through safety-first campaign.

JOB TITLE: Factory Lay-Out Engineer D.O.T. No.: 012 167 018

Major Job Function:

Plans layout of complete departments of industrial plant or commercial establishment to provide maximum possible operating efficiency.

Job Duties:

1. Measures and studies available floor space and draws plan of floor space to scale, using drafting tools.
2. Studies sequence of operations to be performed and flow of materials.
3. Studies and measures machines, conveyors, benches, furnaces, and other equipment.
4. Coordinates all available knowledge and information into a finished scale drawing, showing most efficient location for each piece of equipment and necessary working area around each.

JOB TITLE: Industrial Engineer D.O.T. No.. 012 167 030

Major Job Function:

Plans utilization of production facilities and personnel to improve efficiency of operations in industrial establishment.

Job Duties:

1. Studies functional statements, organizational charts, and project information to determine functions and responsibilities of various workers and work units.
2. Establishes work measurement programs and makes sample observations of work to develop standards of manpower utilization.
3. Analyzes utilization of manpower and machines in units and develops work simplification programs in areas, such as work distribution, work count, process flow, economy of worker motions, and layout of unit.
4. Plans space layout of units to obtain objectives of work measurement and simplification studies.

JS DD 40

JOB TITLE: Agricultural Engineer D.O.T. No.: 013 061 010

Major Job Function:

Applies engineering technology and knowledge of biological sciences to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation, and processing of agricultural products.

Job Duties:

1. Designs and uses sensing, measuring, and recording devices and instrumentation to study such problems as effects of temperature, humidity, and light, on plants or animals, or relative effectiveness of different methods of applying insecticides.

2. Designs and supervises erection of structures for crop storage, animal shelter, and human dwelling, including light, heat, air-conditioning, water supply and waste disposal.

3. May conduct radio and television educational programs to provide assistance to farmers, local groups, and related farm cooperatives.

4. Workers are usually designated according to area of specialty.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

CAMERA AND LENS : TYPES AND USES

DESCRIPTION OF UNIT

This unit will cover the following: a brief history of photography, basic camera and lens types in use today, types of cameras, a brief description of the cameras and a description of various lens types. The materials in this unit are designed for 2 hours of instruction.

Note: Instructor should refer to Unit 10 of this section before starting this unit.

UNIT OBJECTIVE

After completion of this unit the student will be able to name different types of cameras after being given a description of each camera.

PERFORMANCE OBJECTIVE

Upon completion of this unit the student will be able to:

1. Match a drawing of a camera with the name of the camera.
2. Open and load film into the camera.
3. Find the basic parts used to take pictures with the camera.
4. Explain in simple terms the function and operation of the camera lens.
5. List 5 reasons people take pictures.
6. List the steps to making good pictures.

OUTLINE OF CONTENT

I. Types of Cameras

A. "Instant" type Camera-(TM-#1)--Same basic design as the very early box camera. A very easy to use camera that is capable of making good snapshots for photo albums. The main disadvantages are: pictures can be enlarged only to a maximum of 5 x 7 because larger prints tend to get blurred, close-ups can not be made, and it is difficult to take pictures in poor light.

The lens of the "instant" camera is fixed and can not be adjusted to improve picture quality.

B. "Self-Developing" type Camera--The lens of this camera is fixed and can not be adjusted on most "self-developing" cameras. Some "self-developing" types of cameras can be focused (lens adjusted) by moving the lens by means of a bellows system.

The self-developing camera uses film that contains the chemicals needed to complete the developing process. The film which has been exposed to light (taken) is pulled out of the camera between two rollers which starts the developing process.

C. Adjustable Camera--Pictures can be taken up close or far away. The amount of light hitting the film can be controlled in adjustable cameras. The length of time that light strikes the film can also be controlled. By controlling the amount of light and the length of time that it hits the film, pictures can be taken under various conditions. Due to the fact that a very fast shutter speed and large lens opening can be set on an adjustable camera, action shots can also be taken.

1. Single Lens Reflex-Transparency 2--Most popular camera used today and is referred to as the SLR camera. The most popular SLR size is the 35 mm film size, but SLR's are available which have different film sizes and shutter systems. The SLR camera is designed so that what is seen through the viewfinder is what appears on the negative. Single lens reflex camera use prisms and/or mirrors to focus through the lens of the camera.

2. Twin Lens Reflex-Transparency 3--The twin lens reflex camera is a popular adjustable camera. A twin lens reflex camera uses one lens to view the object to be photographed and one lens to allow light through to the film. Twin lens reflex cameras use 120 size film.

D. The other adjustable types of cameras listed below are usually used by professional photographers.

1. Bellows Camera-Transparency 4--The camera could be folded together to make it smaller and protect the bellows. The bellows camera is focused by moving the lens back and forth. No other lens adjustment could be made.

2. Rangefinder-Transparency 5--The focusing of a rangefinder is done by use of a mirror and prism. The two images of the subject are matched for focusing.

3. View Camera-Transparency 6--The use of the view camera began before the Civil War. The back of the camera is a ground glass, which is looked at while the lens is adjusted. Film is placed in the camera after it has been focused. The lens of the view camera is very important because it directly determines the quality of the picture.

E. Motion Picture Cameras--The camera size is given in terms of the film size. The camera sizes in most common use or 8 mm and 16 mm. Cameras have a means for adjusting the lens of the camera. The film is fed through the camera by a battery operated motor which is started and stopped by pressing and releasing the shutter button. The shutter is also controlled by the same button that controls the motor.

II. Loading Film Into The Camera.

To load film into a camera, a person must inspect the camera to find the latch button which allows the back to be opened. The directions sent with most all cameras provides a diagram which shows how to open the camera and how to load the film.

III. The Basic Parts Of The Camera Are:

A. Viewfinder--A device on the camera designed to show the subject area that will be recorded on the film

B. Lens--One or more pieces of optical glass or similar material designed to collect and focus rays of light to form a sharp image on the film.

IV. Camera Lens (Transparency 7)

A. The camera lens and the human eye function in much the same way.

a. Eyeball (whole)--Camera box
b. Eye lens--Camera lens
c. Iris--Camera diaphram
d. Retina--Film
e. Eyelid--Shutter

B. The lens collects the light rays reflected from a subject and focuses the rays into a sharp image.

C. How The Lens Works

1. The camera lens is made from a piece of glass or plastic, which has two opposite surfaces. The surfaces are either both curved or one is curved and the other is flat.

2. The light reflected from the subject passes through the camera lens. As the light passes through the lens it is bent by the lens. The degree to which the light is bent is controlled by the lens make up and the surface curvature.

3. Lens that have been properly ground cause all light rays from the same part of an object to meet at a point behind the lens called the focal point. The image becomes sharp at the point where the light rays meet.

V. Reasons to Photograph

1. Explain information
2. Inform people of what is happening (News)
3. Advertising (Retail Sales)
4. Art (Produce something of beauty)
5. Portrait making
6. Telling a Story
7. Recording History
8. Identification

VI. Steps to making good pictures

1. Keep the camera lens clean and hold the camera steady
2. Choose colorful subjects and objects to be photographed
3. Move close to object to be photographed
4. Pictures should look natural, not posed. (Have people move)
5. Make sure foreground and background adds to the picture
6. Use trees, rocks, and other natural and man-made objects to frame your picture
7. Be sure not to let the center of interest in the picture get lost in the background
8. Make pictures more interesting by changing angles.
9. To get grass, water, etc. try a lower camera angle.
   Change the mood by using different methods of lighting the scene
10. On dark days or in deep shade, brighten the subject by using a flash
11. On bright days move people into a bit of shade.
12. Use a flash inside except with very fast film. (eq. 400 ASA)
13. Use several pictures to tell a story instead of just one.
14. Include pictures of the advertising signs or gates for places visited to add interest.

17. Capture action shots by:

    a. Having action subjects come toward you.
    b. Stop action at its peaks.
    c. "Pan" action by moving camera to follow movement.
    d. On camera with adjustable shutter speeds, use a higher shutter speed.

    Note: It will be extremely helpful to have copies of the following materials for student use.

    Kodak Pocket Guide To Good Pictures, Rochester, New York, New York: Kodak Consumer Markets Division, No. AE-5.

VII. History of Photography

A. Da Vincia used the camera obscur (an artist's drafting tool that projected a scene on a flat surface in the 1500's.

B. Daguerre in 1839 was able to produce a permanent image on a negative.

C. In the 1840's, William Folbot was able to produce paper-based negatives that could produce paper prints.

D. Richard Maddox developed gelatin based negatives in the 1880's.

E. In 1888 George Eastman (an American) developed a hand camera that had the film loaded inside.

TEACHER ACTIVITY

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheets and go through outline of content and give demonstrations.

V. Discuss Student Activity Sheet.

VI. Disucss job sheets.

VII. Review for test.

VIII. Give test.

STUDENT ACTIVITY

I. Read objective sheet.

II. Study information sheet.

III. Complete activity sheet.

IV. Participate in review of material.

V. Take test.

REFERENCES/RESOURCES

I. References

A. Gerace, Philip G.; and Mangoine, Stephen S., Communication:, Photography, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976

B. Lathrap, Irvin; and La Cour, Marshall. The Basic Book of Photography, Chicago, Illinois: American Technical Society, 1979.

C. Kodak Pocket Guide To Good Pictures, Rochester, New York: Kodak Consumer Markets Division, No. AE-5.

II. Resources

A. Objective sheet.

B. Information sheet.

C. Transparency Masters

1. TM1. "Instant" type Camera
2. TM2. Single Lens Reflex
3. TM3. Twin Lens Reflex
4. TM4. Bellows Camera
5. TM5. Rangefinder Camera
6. TM6. View Camera
7. TM7. Eye Camera Comparison

D. Assignment Sheet #1--Learning about your camera.

E. Demonstration #1--Show each student how to use his camera.

F. Student Activity #1--Load film into your camera and take pictures.

Information Sheet #1

I. Types of Cameras

A. "Instant" type Camera-(TM #1)--Same basic design as the very early box camera. A very easy to use camera that is capable of making good snapshots for photo albums. The main disadvantages are: pictures can be enlarged only to a maximum of 5 x 7 because larger prints tend to get blurred, close-ups can not be made, and it is difficult to take pictures in poor light.

The lens of the "instant" camera is fixed and can not be adjusted to improve picture quality.

B. "Self-Developing" type Camera--The lens of this camera is fixed and can not be adjusted on most "self-developing" cameras. Some "self-developing" types of cameras can be focused (lens adjusted) by moving the lens by means of a bellows system.

The self-developing camera uses film that contains the chemicals needed to complete the developing process. The film which has been exposed to light (taken) is pulled out of the camera between two rollers which squeezes the chemical onto the film and starts the developing process.

C. Adjustable Camera--Pictures can be taken up close or far away. The amount of light hitting the film can be controlled in adjustable cameras. The length time light strikes the film can also be controlled. By controlling the amount and the time light hits the film, pictures can be taken under various conditions.

Adjustable cameras can also be used to take action pictures.

1. Single Lens Reflex-Transparency 2--Most popular camera used today and is referred to as the SLR camera. The most popular SLR size is the 35 mm film size, but SLR's are available which have different film sizes and shutter systems. The SLR camera is designed so that what is seen through the viewfinder is what appears on the negative. Single lens reflex camera use prisms and/or mirrors to focus through the lens of the camera.

2. Twin Lens Reflex-Transparency 3--The twin lens reflex camera is a popular adjustable camera. A twin lens reflex on lens to view the object to photograph and on lens to take pictures. Twin lens reflex cameras use 120 size film.

D. The other adjustable type of cameras listed below are usually used by professional photographers.

1. Bellows Camera-(TM #4)--The camera could be folded together to make it smaller and protect the bellows. The bellows camera is focused by moving the lens back and forth. No other lens adjustment could be made.

2. Rangefinder-(TM #5)--The focusing of a rangefinder is done by the use of a mirror and prism. The two images of the subject are matched for focusing.

3. View Camera-(TM #6)--The use of the view camera began before the Civil War. The back of the camera is a ground glass, which is looked at while the lens is adjusted. Film is placed in the camera after it has been focused. The lens of the view camera is very important because it directly determines the quality of the picture.

E. Motion Pictures Cameras--The camera size is given in terms of the film size. The camera sizes in most common use are 8 mm, 16 mm, and 35 mm. Most motion picture cameras have adjustable zoom lenses. The film is fed through the camera by a battery operated motor which is started and stopped by pressing and releasing the shutter button. The shutter is also controlled by the same button that controls the motor.

II. The basic parts of the camera are:

A. Viewfinder--A device on the camera designed to show the subject area that will be recorded on the film.

B. Lens--One or more pieces of optical glass or similar material designed to collect and focus rays of light to form a sharp image on the film.

III. Camera Lens

A. The camera lens and the human eye function in much the same way.

a. Eyeball (whole)--Camera box
b. Eye lens--Camera lens
c. Iris--Camera diaphram
d. Retina--Film
e. Eyelid--Shutter

B. The lens collects the light rays reflected from a subject and focuses the rays into a sharp image.

C. How the lens works

1. The camera lens is made from a piece of glass or plastic, which have two opposite surfaces. The surfaces are either both curved, or one is curved and the other is flat.

2. The light reflected from the subject passes through the lens. As the light passes through the lens it is bent by the lens. The degree to which the light is bent is controlled by the lens make-up and the surface curvature.

3. Lens that have been properly ground cause all light rays from the same part of an object to meet at a point behind the lens called the focal point. The image becomes sharp at the point where the light rays meet.

IV. Types of lens.

1. Normal--Photographs things as they actually are with little distortion.

2. Wide Angle--Makes scenes, objects and rooms stretch out to infinity. It has a shorter focal length and a wider field of view than a normal lens.

3. Telephoto--Brings objects that are far away in closer as a longer focal length and a narrower field of view than a normal lens.

4. Close-up--It has an extremely short focal length and is used to photograph things extremely close up.

5. Zoom--This lens can have its focal length adjusted over a wide range.

V. History of Photography

A. Da Vincia used the camera obscura (an artist's drafting tool that projected a scene on a flat surface in the 1500's.)

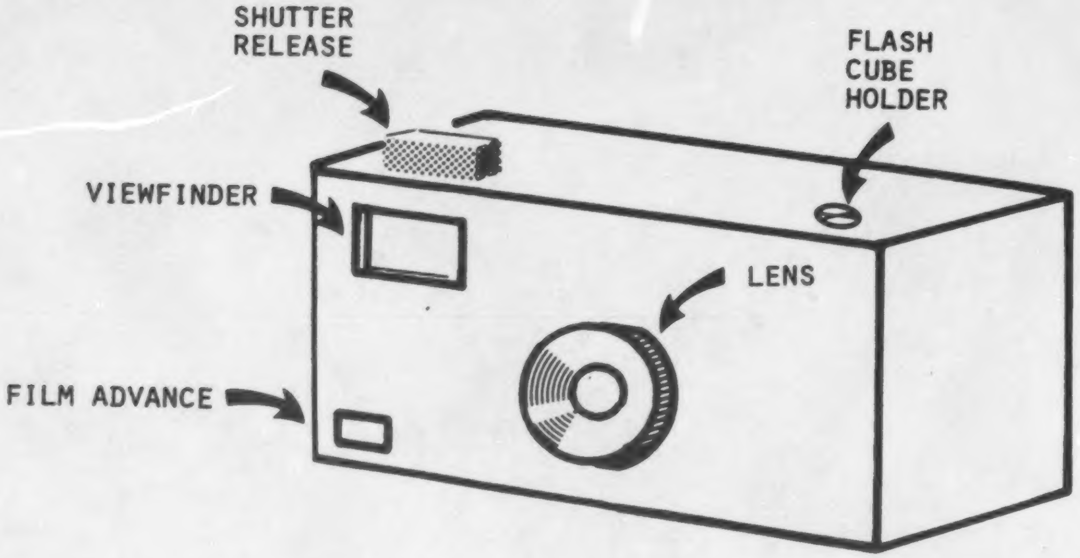
B. Daguerre in 1839 was able to produce a permanent image on a negative.

C. In the 1840's, William Folbot was able to produce paper-based negatives that could produce paper prints.

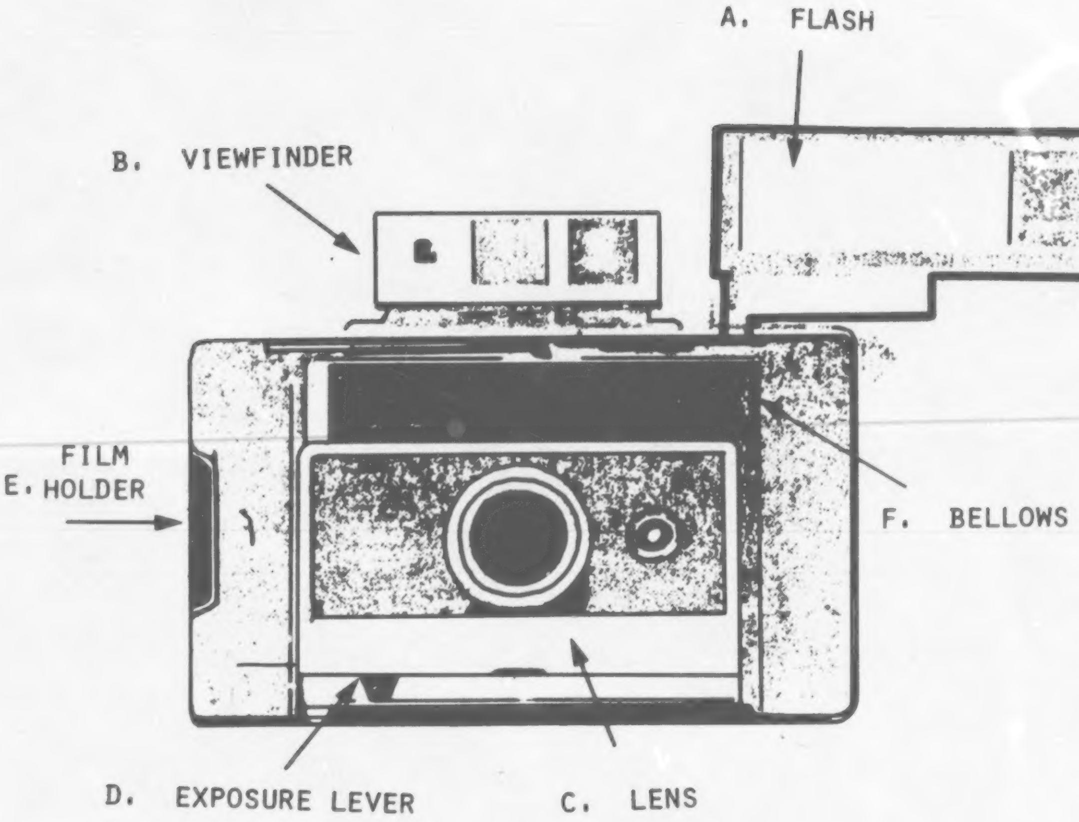
D. Richard Maddox developed gelatin based negatives in the 1880s.

E. In 1888 George Eastman (an American) developed a hand camera that had the film loaded inside.

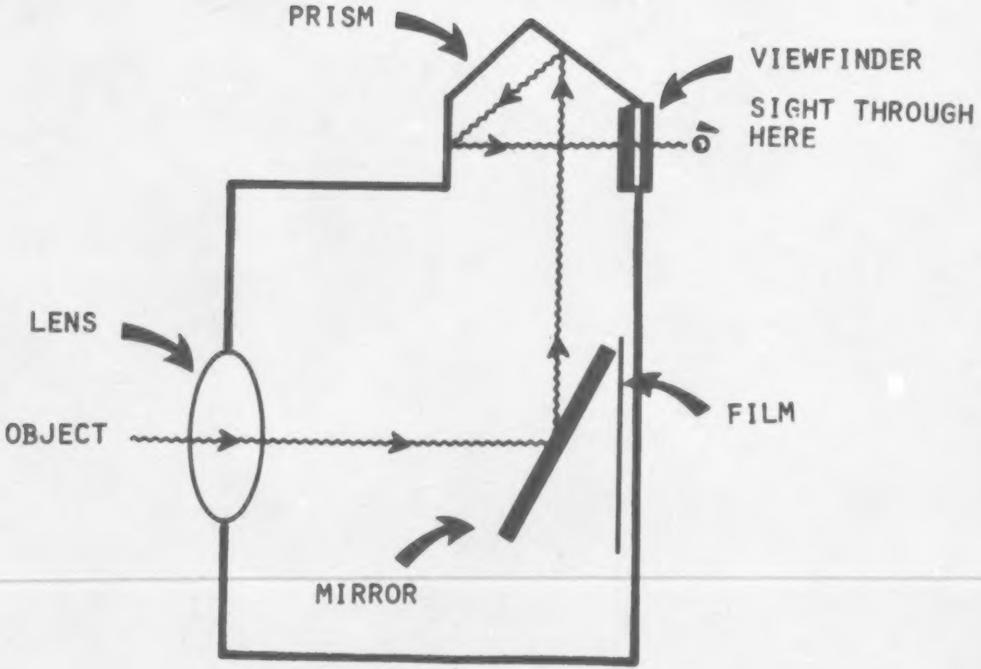
INSTANT TYPE CAMERA


SHUTTER RELEASE
FLASH CUBE HOLDER
VIEWFINDER
LENS
FILM ADVANCE

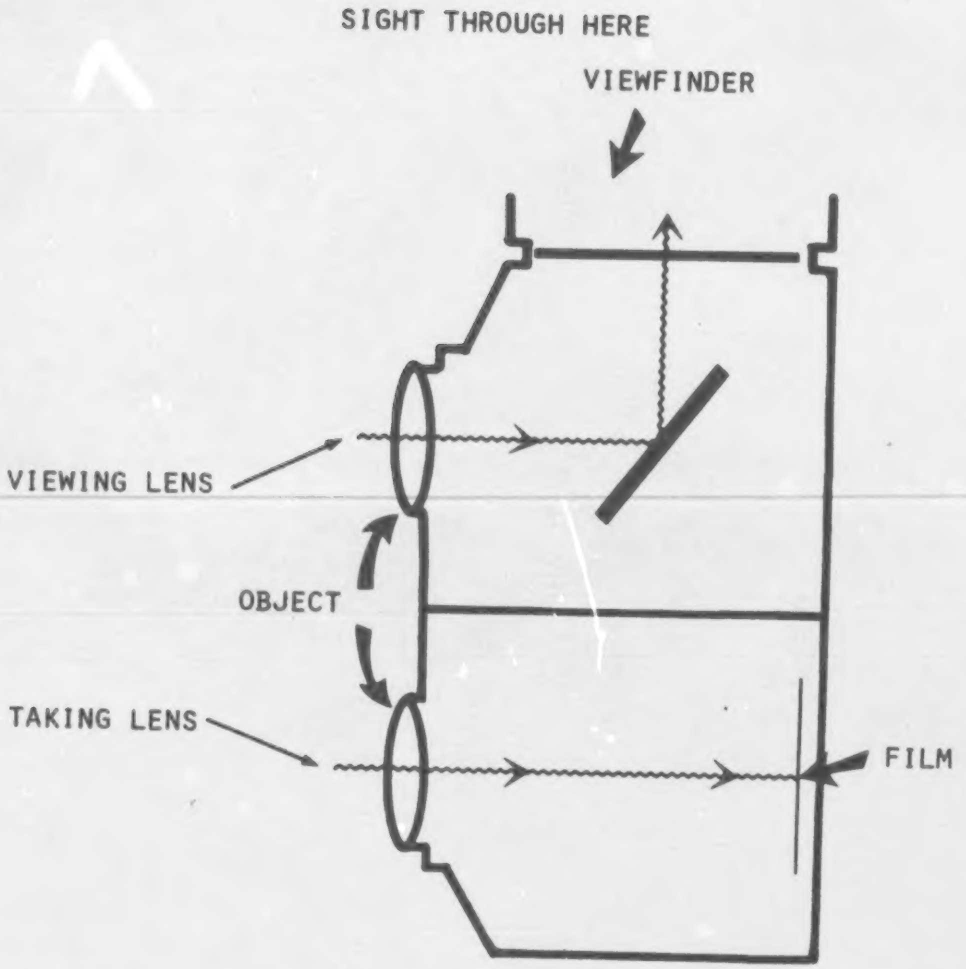
SELF DEVELOPING CAMERA


A. FLASH
B. VIEWFINDER
E. FILM HOLDER
F. BELLOWS
D. EXPOSURE LEVER
C. LENS

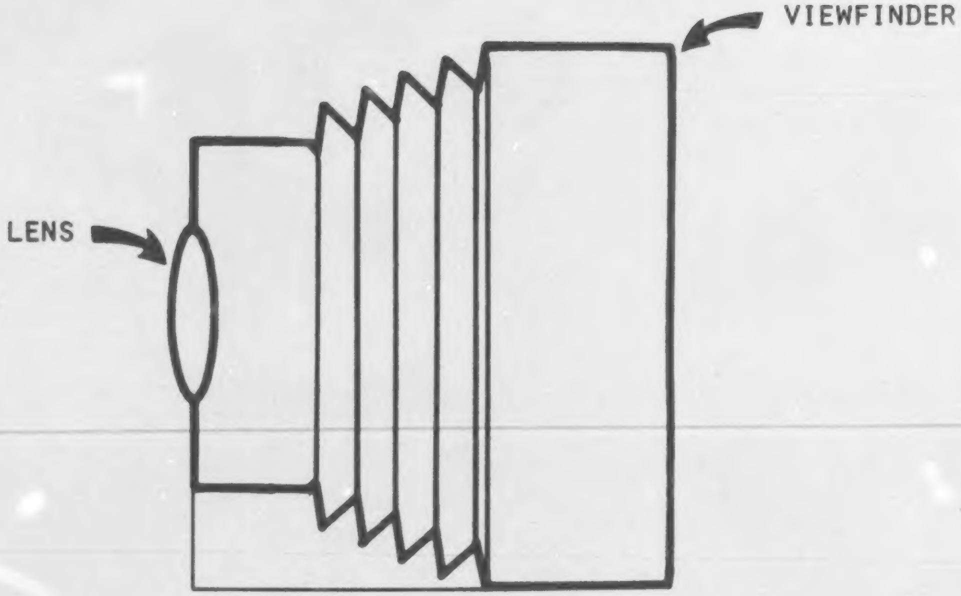
SINGLE LENS REFLEX


PRISM
VIEWFINDER
SIGHT THROUGH HERE
LENS
OBJECT
FILM
MIRROR

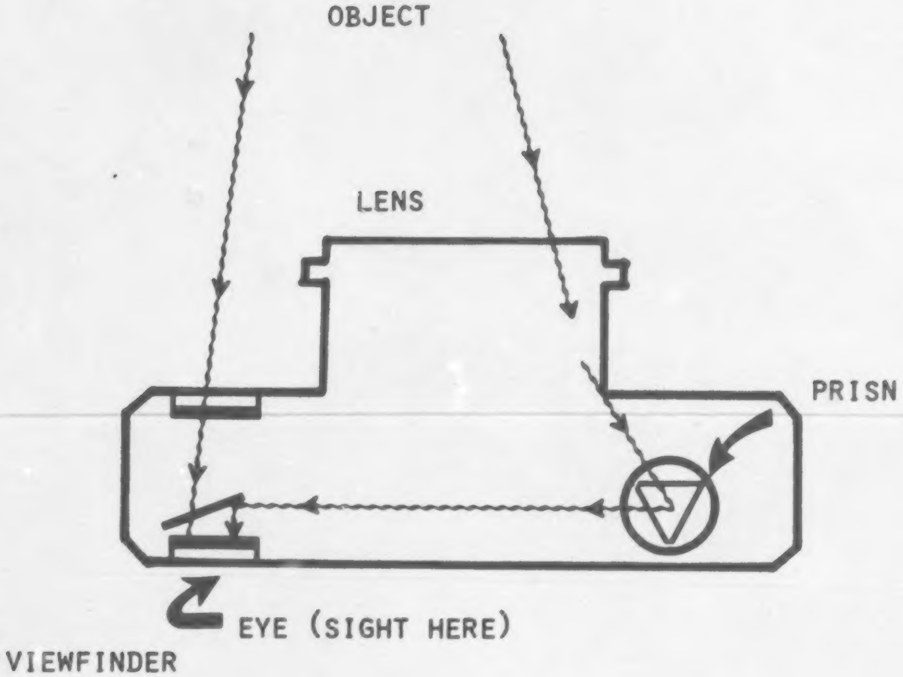
TWIN LENS REFLEX


SIGHT THROUGH HERE
VIEWFINDER
VIEWING LENS
OBJECT
TAKING LENS
FILM

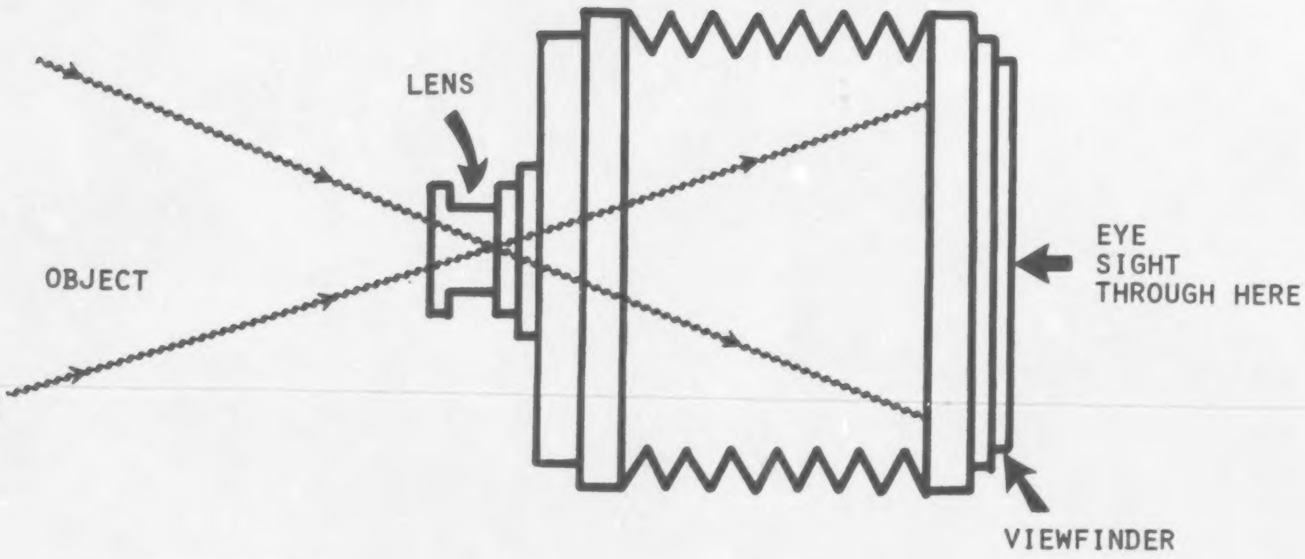
BELLOWS CAMERA


VIEWFINDER
LENS

RANGEFINDER CAMERA


OBJECT
LENS
PRISN
EYE (SIGHT HERE)
VIEWFINDER

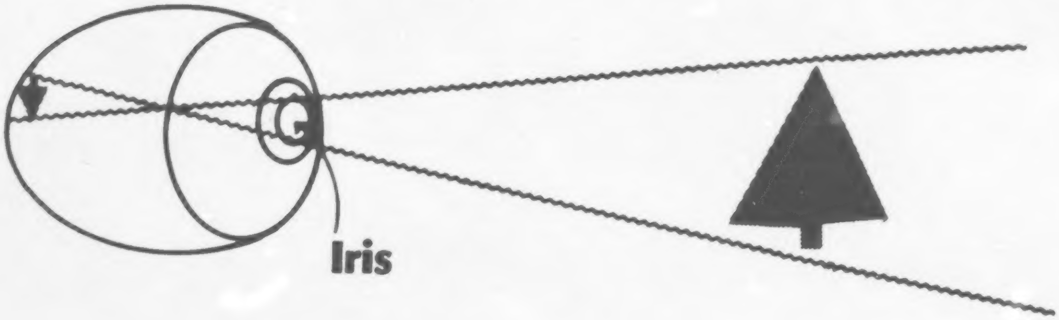
VIEW CAMERA

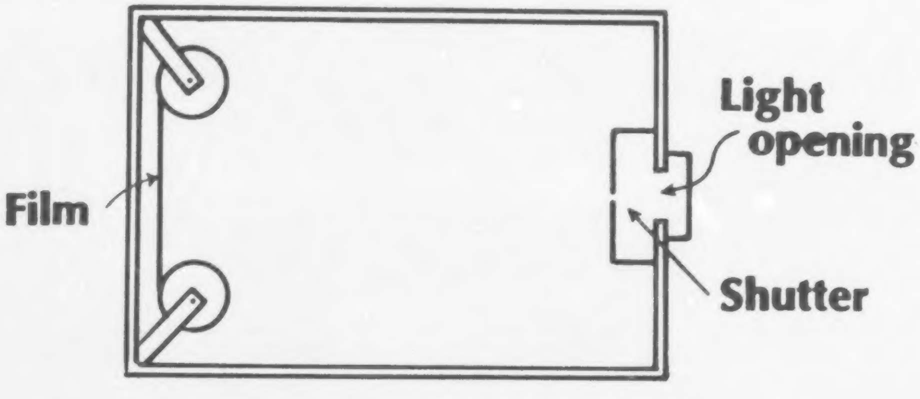

LENS
OBJECT
EYE
SIGHT
THROUGH HERE
VIEWFINDER

T.M.-7 / PH I.II-G

470

EYE-CAMERA COMPARISON




Film
Light opening
Shutter

Light tight box

Assignment Sheet #1

Learning About Your Camera

Each student will bring to class the type of camera he has at home. Each student will become familiar with the parts and operation of the camera. Students should learn how to load film into their respective cameras.

Demonstration #1

How To Use Your Camera

Objective

Each student should learn how to use the camera that is available for him to use.

Materials

Each student should bring to school whatever camera that is available to them at home.

Procedure

1. The instructor will show each student how to load film into the camera.

2. Students will also learn the function of the parts to the camera that will be used.

Principle

Students should learn how to operate the camera from observing the instructor during the demonstration. To successfully take pictures the students must know the purpose of each part of the camera.

Student Activity #1

LOADING FILM

Objective

You will take the materials given and correctly complete the following:

1. Load film into your camera;
2. Tell the function of each camera part.

Materials

1. The student furnished camera.
2. A roll of black and white film for the student furnished camera.

Procedures

1. Have instructor watch as you complete the activity.
2. Open the camera back by pressing the button which releases the camera back.
3. Place film in the camera.
    a. Cartridge film is ready for use.
    b. Film that has to have a leader (35 mm) must be threaded onto film advance.
4. Close camera back.
5. Explain the function of each camera part.

TEST 1

Match the terms on the right to the correct description.

1. _____ was the American who developed a hand-held camera that had the film in it.

2. _____ was able to produce a permanent image on a negative.

3. _____ used the camera obscurer as a photographic tool.

4. _____ developed a gelatin based negative.

5. _____ produced a paper-based negative that could produce paper prints.

A. Talbot

B. Daguere

C. Maddox

D. Da Vincia

E. Eastman

TEST 2

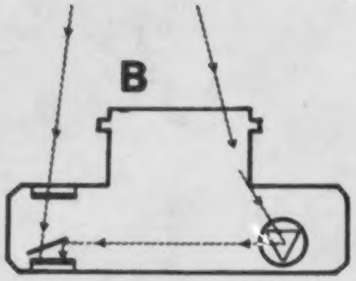
Match the parts of the eye to the parts of the camera which serves the same function.

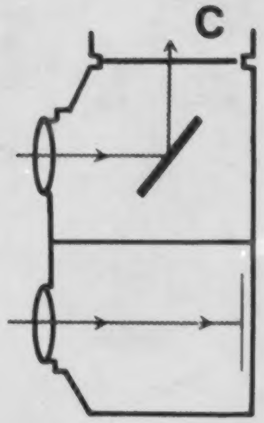
Eyeball (Whole)	Shutter
Eye lens	Camera diaphram
Iris	Camera lens
Retna	Film
Eyelid	Camera Box

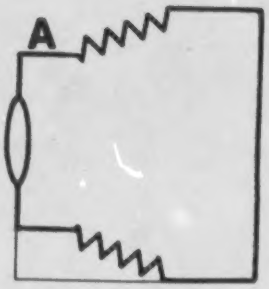
TEST 3

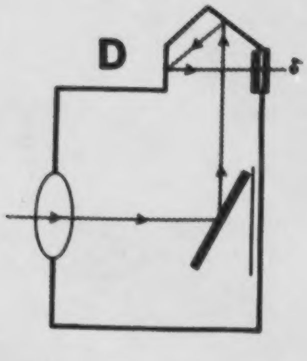
Match the names on the right to the diagrams of the cameras on the following page.

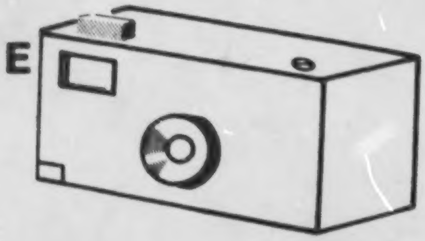
A. ________________________________	2. Bellows
B. ________________________________	4. Rangefinder
C. ________________________________	1. Twin Lens Reflex
D. ________________________________	5. Single Lens Reflex
E. ________________________________	3. Instant


B


C


A


D


E

ANSWERS TO TEST

TEST 1

1. E 2. B 3. D 4. C 5. A

TEST 2

Eyeball (whole)--Camera bix

Eye lens--Camera lens

Iris--Camera Diaphram

Retina--Film

Eyelid--Shutter

TEST 3

A. 2 B. 4 C. 1 D. 5 E. C

PH 1.20

EQUIPMENT/SUPPLIES

I. Equipment

  A. Student supplied camera's

II. Supplies

  A. Student supplied film

  B. 24 - *Kodak Pocket Guide To Good Pictures*, Rochester, New York: Kodak Consumer Markets Division, No. AE-5.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

PICTURE MAKING WITH AUTOMATIC CAMERAS

DESCRIPTION OF UNIT

This unit will cover the basic parts and operation of the box (instant) camera and self-developing (Polaroid) camera. The materials in this unit are designed for 2 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify the basic parts of a camera, load film into a camera, expose the film, and unload the film. Students will use the camera that they have access to.

PERFORMANCE OBJECTIVES

Upon completion of this unit the student will be able to:

1. Identify the basic parts of a camera and be able to match their names to the proper parts on a diagram of the camera.
2. With a given camera and a cartridge of film the student should demonstrate the ability to:
   a. Load the camera.
   b. Expose the film.
   c. Unload the film to the degree of producing printable negatives without damaging or fogging the film.

OUTLINE OF CONTENT

1. Parts of the Instant Camera (Transparency #1)

   Demo #1--Show how to load and operate the Instant camera

   A. Viewfinder

   B. Shutter Release

   C. Flash Cube Holder

   D. Film Advance

   E. Lens

2. Parts of the Self-Developing (Poloraid) (Transparency #2)

   Demo #2--Show students how to load and operate the self developing camera.

3. Film

   A. Cartridge

   B. Self-Developing

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheets and go through outline of material and give demonstrations.

V. Discuss student activity sheets and help students choose the sheet they will use. Students may do only the activities and learn the information for the camera they have.

VI. Discuss job sheets.

VII. Review for test.

VIII. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Be able to properly expose the film so the result will be a printable negative without damage or fogging, or a quality picture with your own camera.

V. Participate in review of material.

VI. Take test.

REFERENCE/RESOURCES

I. References
   A. Gerace, Philip G.; and Mangoine, Stephen S., Communications: Photography, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

   B. Lathrop, Irvin; and La Cour. The Basic Books of Photography, Chicago, Illinois: American Technical Society, 1979.

II. Resources

   A. Objective sheet

   B. Information sheet

   C. Transparency masters
      1. TM1--Parts of the Instant Type Camera

      2. TM2--Parts of the Self-Developing Camera

   D. Assignment sheet #1--Identifying the parts of the instant type camera

   E. Demonstration #1--Demonstrate how to load and operate the Instant camera.

   F. Student Activity #1--Take a roll of pictures and have them developed.

   G. Student Activity #2--Identify the parts of a self-developing camera.

   H. Demonstration #2--Demonstrate how to load and operate a self-developing camera.

   I. Student Activity #3--Take a roll of self-developing pictures.

   J. Student Activity #4.

Information Sheet #1

I. Terms and Definitions for Instant Cameras.

A. Viewfinder--A window which is connected to the lens and lets the camera operator see what will show up on the film.

B. Shutter Release--The button that causes the shutter to be tripped and allows the picture to be taken

C. Flash Cube Holder--The holding device that holds the flash cube which produces better lighting for a picture under poor lighting conditions.

D. Film advance--The lever which controls the movement of film from an exposed frame forward to an unexposed frame.

E. Lens--The glass opening which reduces the image to film size and focuses a clear and sharp picture on the film.

F. Aperture--Lens opening. The opening in a lens system through which light passes. The size of the aperture is limited on these cameras.

Information Sheet #2

I. Terms and Definitions for Self-Developing camera.

A. Viewfinder--A window which is connected to the lens and lets the camera operator see what will show up on the film.

B. Shutter Release--The button that causes the shutter to be tripped and allows the picture to be taken.

C. Flash Cube Holder--The holding device that holds the flash cube which produces better lighting for a picture under poor lighting conditions.

D. Film advance--The lever which controls the movement of film from an exposed frame forward to an unexposed frame.

E. Lens--The glass opening which reduces the image to film size and focuses a clear and sharp picture on the film.

F. Aperture--Lens opening. The opening in a lens system through which light passes. The size of the aperture is limited on these cameras.

II. Film develops in the following way:

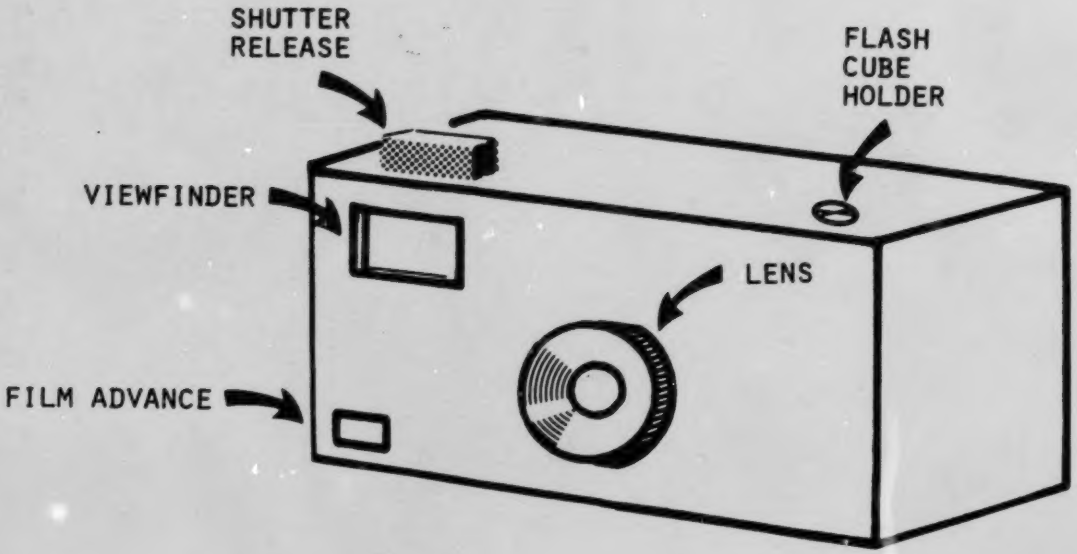
A. Film has the chemicals needed to cause the film to develop.

B. Film is pulled between two rollers.

C. Rollers cause the developing chemicals to be mashed on the film and start the developing process.

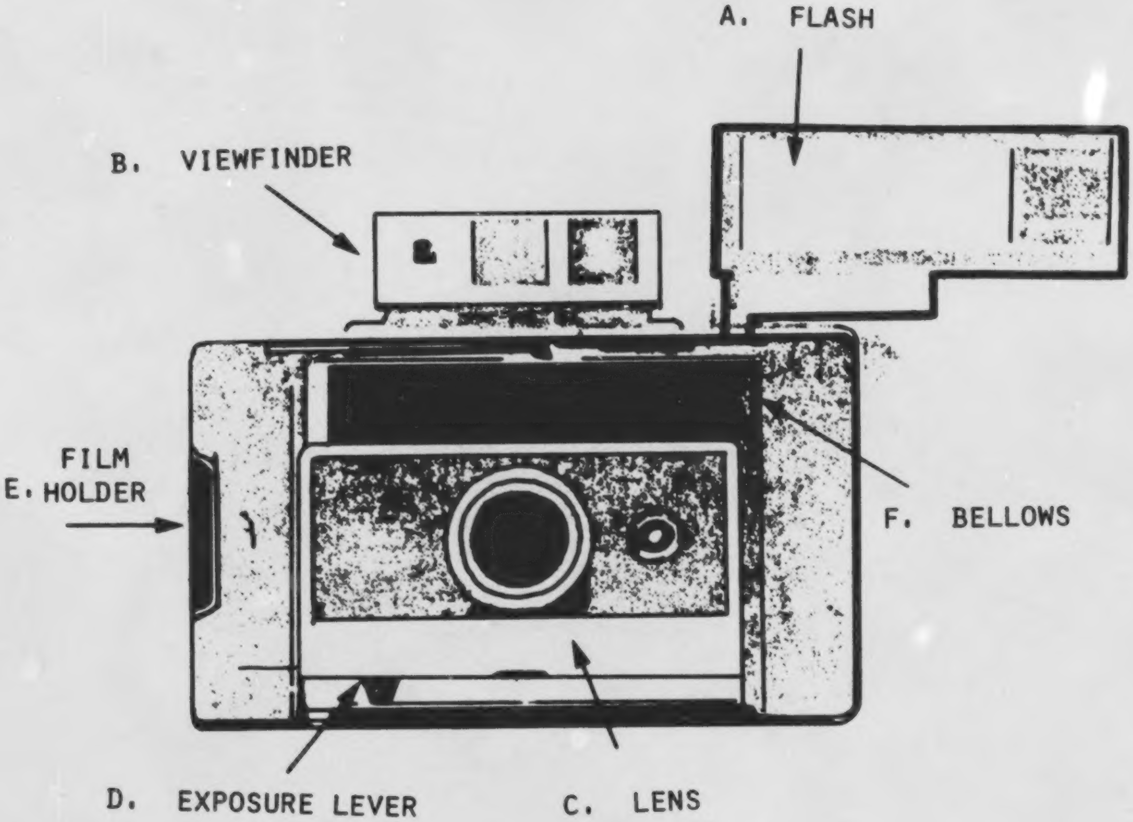
D. Hold the picture, expose it to light or remove protective paper (if it has it).

INSTANT TYPE CAMERA


SHUTTER RELEASE
FLASH CUBE HOLDER
VIEWFINDER
LENS
FILM ADVANCE

T.M.-1/PH 2.7-A

SELF DEVELOPING CAMERA


A. FLASH
B. VIEWFINDER
E. FILM HOLDER
F. BELLOWS
D. EXPOSURE LEVER
C. LENS

Demonstration #1

LOADING AND OPERATING AN INSTANT CAMERA

Objective

To show students how to properly load and shoot quality pictures with an instant camera and remove the film.

Materials

1 "Instant" type camera
1 cassette (cartridge) of 110 or 126 film

Procedure

1. While holding the camera in the left hand, push the button on the side of the camera body to release the catch which holds the back closed.

2. Open the camera back and place the film cartridge into the camera following the instructions on the cartridge.

3. After the film has been placed in the camera, you are ready to take pictures.

4. To take pictures:

   a. Pick out the objects, people or scene to be photographed.
   b. Look through the camera viewfinder to find the most pleasing arrangement of what is to be photographed.
   c. After the most pleasing arrangement of the object to be photographed has been seen in the viewfinder, push the shutter release button while holding the camera still.
   d. Push the film advance to advance to the next frame
   e. You are now ready to take the next picture.
   f. Repeat steps a through e.

5. After the cartridge of film has been used up, unload the cartridge from the camera by following these steps:

   a. Place camera in left hand.
   b. Push the button on the side of the camera body to release the catch on the back.
   c. Open the camera back and remove the film cartridge.

6. Take the film cartridge to be developed.

Principle

An instant camera is a lighttight box with a lens which controls the light which reaches the film. The lens has a shutter behind it and is opened by pressing the shutter release allowing the light rays to strike the film.

Demonstration #2

LOADING AND OPERATING THE SELF-DEVELOPING CAMERA

Objective

To show students how to properly load, shoot and develop pictures using the self-developing camera.

Materials

1 Self-Developing Camera
1 cassette (cartridge) of self-developing film for above camera

Procedure

1. While holding the camera in the left hand, push the button on the side of the camera body to release the catch which holds the back closed.

2. Open the camera back and place the film cartridge into the camera following the instructions on the cartirdge.

3. After the film has been placed in the camera, you are ready to take pictures.

4. To take pictures:

    a. Pick out the objects, people or scene to be photographed.

    b. Look through the camera viewfinder to find the most pleasing arrangement of the object to be photographed.

    c. After the most pleasing arrangement of the object to be photographed has been seen in the viewfinder, push the shutter release button while holding the camera still.

    d. Pull the previous taken picture through the developing rollers to the outside of the camera so the developing chemicals will start the developing process on the film by being spread on the film.

    e. If the picture has a paper cover on it, remove the paper covering.

    f. Film not having a paper cover develops after being removed from the camera.

    g. You are now ready to take the next picture.

    h. Repeat steps a through f.

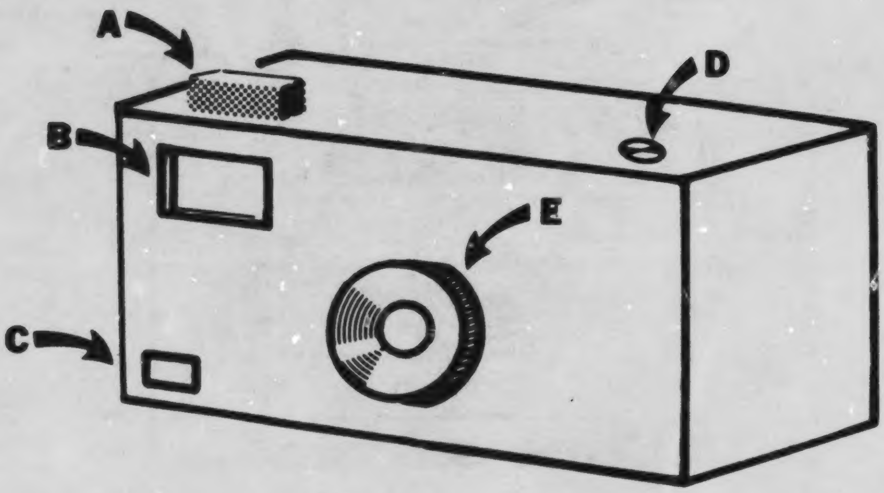
5. After all the pictures have been taken, open the camera back and remove the empty cartridge.

Principle

A self-developing camera is a lighttight box with a lens which controls the light which reaches the film. The lens has a shutter behind it which keeps light from striking the film until the desired picture is seen in the viewfinder. The shutter is opened by pressing the shutter release allowing light rays to strike the film. The film is then pulled between two rollers which causes developing chemicals on the film to be spread over the film which starts the developing process. The picture develops outside the camera.

Assignment Sheet #1

Identify the parts of the instant camera in this picture.



A. ______________________

B. ______________________

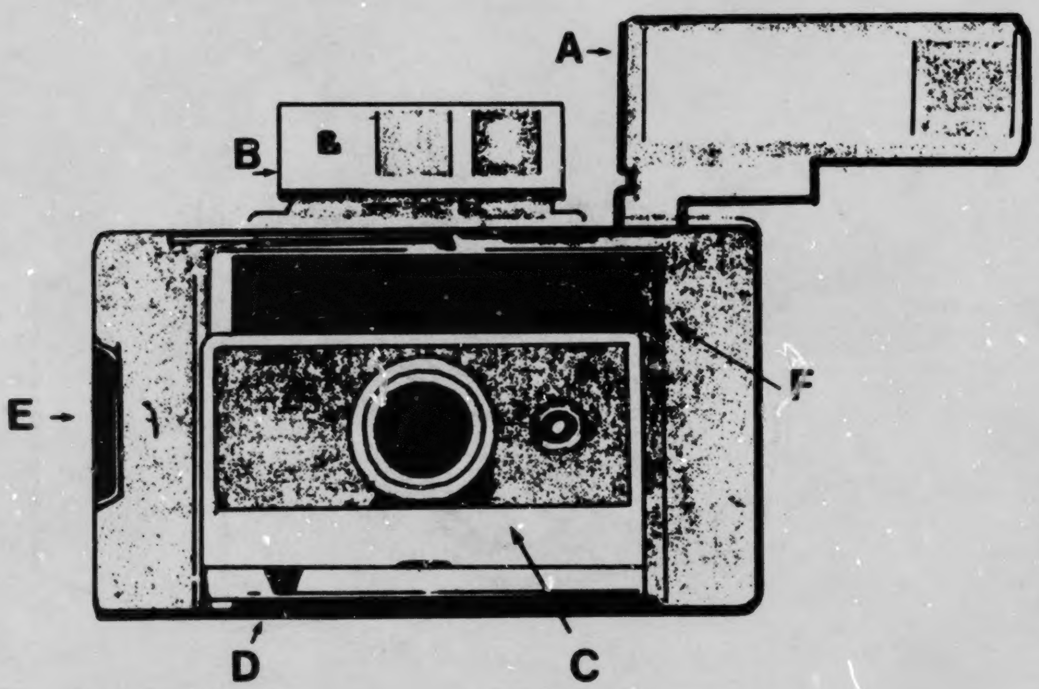
C. ______________________

D. ______________________

E. ______________________

F. ______________________

Identify the parts of the self-developing camera in this picture.



A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

Student Activity #1

TAKING PICTURES WITH YOUR CAMERA

Objective

You will take the materials given and correctly complete the following:

(1) load the film cartridge into the instant camera,

(2) take pictures, and

(3) remove film cartridge using your camera.

Materials

1 "Instant" type camera.
2. 1 cassette (cartridge) of 110 or 126 film

Procedure

1. While holding the camera in the left hand, push the button on the side of the camera body to release the catch which holds the back closed.

2. Open the camera back and place the film cartridge into the camera following the instructions on the cartridge.

3. After the film has been placed in the camera, you are ready to take pictures.

4. To take pictures:

    a. Pick out the objects, people or scene to be photographed.
    b. Look through the camera viewfinder to find the most pleasing arrangement of what is to be photographed.
    c. After the most pleasing arrangement of the object to be photographed has been seen in the viewfinder, push the shutter release button while holding the camera still.
    d. Push the film advance to advance to the next frame
    e. You are now ready to take the next picture.
    f. Repeat steps a through e.

5. After the cartridge of film has been used up, unload the cartridge from the camera by following these steps:

    a. Place camera in left hand.
    b. Push the button on the side of the camera body to release the catch on the back.
    c. Open the camera back and remove the film cartridge.

6. Take the film cartridge to be developed.

Principle

An instant camera is a lighttight box with a lens which controls the light which reaches the film. The lens has a shutter behind it and is opened by pressing the shutter allowing the light rays to strike the film.

Student Activity #3

Objective

You will take the materials given and correctly complete the following:

(1) load the film cartridge into the camera,

(2) take pictures; and

(3) cause the film to start self-development with your own camera.

Materials

1 Self-Developing Camera (student owned)
1 Cassette (cartridge) of self-developing film for above camera

Procedure

1. While holding the camera in the left hand, push the button on the side of the camera body to release the catch which holds the back closed.

2. Open the camera back and place the film cartridge into the camera following the instructions on the cartridge.

3. After the film has been placed in the camera, you are ready to take pictures.

4. To take pictures:

   a. Pick out the objects, people or scene to be photographed.

   b. Look through the camera viewfinder to find the most pleasing arrangement of the object to be photographed.

   c. After the most pleasing arrangement of the object to be photographed has been seen in the viewfinder, push the shutter release button while holding the camera still.

   d. Pull the exposed film through the developing rollers to the outside of the camera so the developing chemicals will start the developing process on the film by being spread on the film.

   e. If the picture has a paper cover on it, remove the paper covering.

   f. Film not having a paper cover develops after being removed from the camera.

g. You are now ready to take the next picture.

h. Repeat steps a through f.

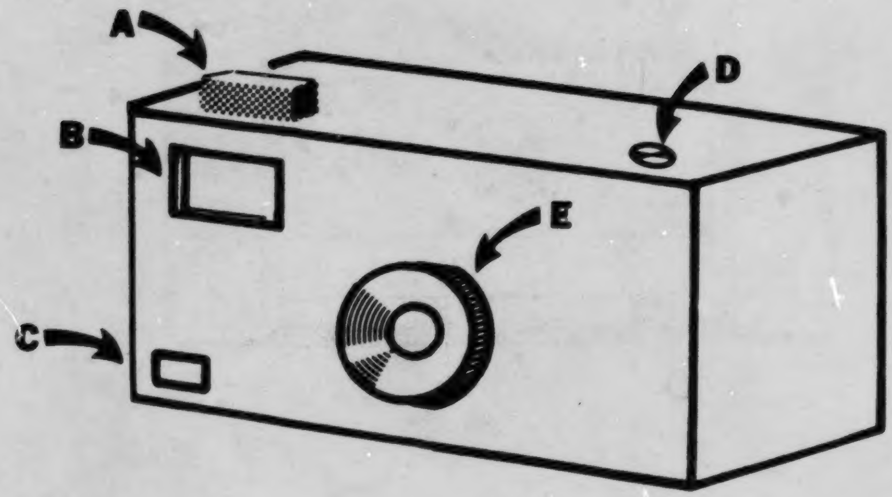
5. After all the pictures have been taken, open the camera back and remove the empty cartridge.

Principle

A self-developing camera is a lighttight box with a lens which controls the light which reaches the film. The lens has a shutter behind it which keeps light from striking the film until the desired picture is seen in the viewfinder. The shutter is opened by pressing the shutter release allowing light rays to strike the film. The film is then pulled between two rollers which causes developing chemicals on the film to be spread over the film which starts the developing process. The picture develops outside the camera.

TEST 1

Parts of the Instant Camera.



A. ____________________

B. ____________________

C. ____________________

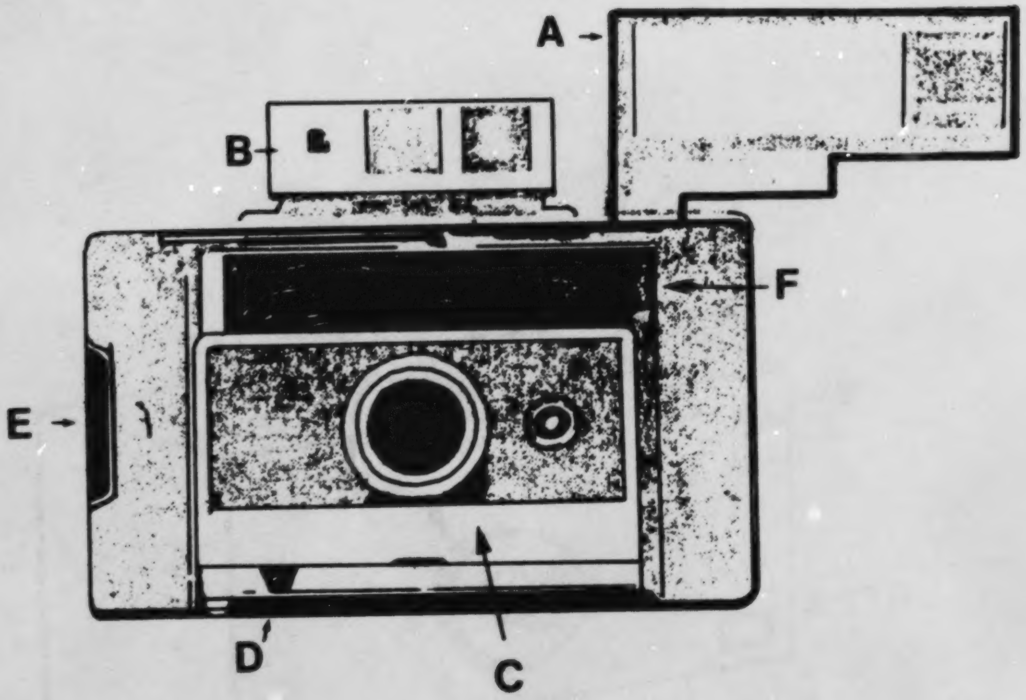
D. ____________________

E. ____________________

F. ____________________

PH 2.19

Parts of the self-developing camera.



A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

ANSWERS TO TEST

TEST 1

A. Shutter Release

B. Film Advance

C. Flash Cube Holder

D. Viewfinder

E. Lens

F. Aperture

TEST 2

A. Aperture

B. Lens

C. Flash Holder

D. Shutter Release

E. Viewfinder

EQUIPMENT/SUPPLIES

I. Equipment

  A. 1 Instant Camera

  B. 1 Self-Developing Camera

II. Supplies

  A. 1 cartridge of 110 or 126 film

  B. 1 cartridge of self-developing film

  C. 4 bottles of lens cleaning fluid

  D. 4 packages of lens cleaning tissue

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

CAMERA CONSTRUCTION AND OPERATION

DESCRIPTION OF UNIT

This unit will cover the basic parts of the 35 mm SLR camera and its operation. It will give information on the following areas: history of photography, camera construction, camera operation, camera theory and terminology, associated with the camera. This unit of instruction will require approximately ten hours of instructional time.

UNIT OBJECTIVE

After completion of this unit, the student will be able to give a brief history of photography, identify the basic parts of a camera, load film into a camera, expose the film, and unload the film. Students will use the 35 mm SLR camera as the camera for this unit of instruction.

PERFORMANCE OBJECTIVES

Upon completion of this unit the student will be able to:

1. Explain how the camera works.
2. Match terms associated with camera construction to the correct definition.
3. Identify the basic parts of a camera and be able to match their names to the proper parts on a diagram of a camera.
4. With a given camera and a roll of film the student will demonstrate the ability to:
    a. Load the camera
    b. Expose the film
    c. Unload the film

    to the degree of producing printable negatives without damaging or fogging the film.

OUTLINE OF CONTENT

I. Parts of the Camera (Transparency 1)

  A. Shutter speed dial

  B. Advance lever

  C. Shutter release

  D. Frame counter (automatic reset exposure counter)

  E. Timer (self-timer cocking lever)

  F. Focusing ring

  G. Flash terminal

  H. Preview button

  I. Viewfinder

  J. Rewind knob

  K. Rewind Crank

  L. Hot shoe

  M. Lens

  N. Body

II. Shutter Types (Transparency 2)

  A. Leaf Shutter

  B. Focal Plane

III. Shutter Speed-Lens Opening (Transparency 3)

  A. As you go to a faster shutter speed the F-stop is opened a stop.

  B. As you step down the F-stop, a slower speed is needed.

IV. Pinhole Camera (Transparency 4) Demo #1 - Show students how to make a pinhole camera.

  A. Box type

  B. Can type

  C. Cartridge

D. Material needed and sizes

V. Viewing angles of lens (Transparency 5)

A. Wider viewing angles make objects look farther apart.

B. Narrower viewing angles make objects look closer together.

VI. Lens Openings (Transparency 6)

A. Large F-stop means a smaller lens opening.

B. Smaller F-stop means a larger lens opening.

VII. Focusing Systems (Transparency 7)

A. Coindent (Grids)

B. Split image

VIII. Depth of Field (Transparency 8)

IX. Focal Length of Lens

A. 55 MM

B. 200 MM

C. Zoom

TEACHER ACTIVITIES

I. Provide student with student module

II. Make transparencies

III. Discuss unit and specific objectives

IV. Discuss information sheets and go through outline of material and give demonstrations

V. Discuss student activity sheets

VI. Discuss job sheets

VII. Review for test

VIII. Give test

STUDENT ACTIVITIES

I. Read objective sheet

II. Study information sheet

III. Complete activity sheets

IV. Be able to give a brief history of the camera and properly expose film so the result will be a printable negative without damage or fogging.

V. Participate in review of material

VI. Take test

REFERENCES/RESOURCES

I. References

A. Gerace, Philip G.; and Mangiane, Stephen S. Communication: Photography. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

B. How to Make and Use a Pinhole Camera, Rochester, New York: Kodak, Consumer Markets Division, No. AA5, 1971.

C. Muse, Ken. Photo One. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

II. Resources

A. Objective sheet

B. Information sheet

C. Transparency Masters

1. TM 1. Parts of the Camera.
2. TM 2. Shutter Types.
3. TM 3. Shutter Speed--Lens Opening.
4. TM 4. Pinhole Camera.
5. TM 5. Viewing angle of the lens.
6. TM 6. Lens Opening Sizes.
7. TM 7. Focusing Screens.
8. TM 8. Depth of Field.
9. TM 9. Local Lengths of Lens

D. Assignment sheet #1--Identify the parts of the camera.

E. Demonstration #1--Make a pinhole camera.

F. Student Activity #1--Take and have pictures developed with camera.

G. Student Actvity #2--Load, expose, and unload one 36 exposure roll of film.

PH 3.7

Information Sheet #1

I. Terms and Definitions

A. Shutter Speed Dial--An indexed dial which set the shutter at the desired speed.

B. Advance Lever--The lever which controls the movement of film from an exposed frame forward to an unexposed frame.

C. Shutter Button--The button that causes the shutter to be tripped allowing the picture to be taken.

D. Frame Counter(Automatic reset exposure counter)--Shows how many frames have been exposed

E. Timer--A device which allows a time period to elapse between the time the shutter button is pushed and the picture taken.

F. Focusing Ring--The movable ring on the lens which adjusts the lens to get pictures in focus.

G. Depth of Field--The focus area of a camera.

H. Depth of field preview button--This button allows the scene to be seen as it looks at a particular F-stop setting (lens setting).

I. Viewfinder--Shows the image that is seen by the lens of the camera.

J. Rewind Knob--Used to rewind film into cartridge after the entire of film has been exposed. roll

K. Rewind Crank--Part of the rewind knob used to rewind film.

L. Hot shoe--The holding device (marked with a red X) on the top of the camera used to hold the electronic flash.

M. Lens--The glass opening which reduces the image to film size and produces a clear and sharp picture on the film. Controls the focusing and F-stop setting of the camera.

1. Wide angle--Make scenes, objects and rooms stretch out to infinity. Has a shorter focal length and a wider field of view than a normal len.
2. Telephoto--Bring objects which are far away in closer. Has a longer focal length and narrower field of view than normal lens.
3. Normal--Shows the things as they actually are with little distortion.
4. Zoom--A lens which can have its focal length adjusted a over a wide range.

N. Body--That part of the camera that holds the film and has the other parts of the camera attached to it.

O. F-stop--The size of the lens opening: This controls the amount of light exposed to the film.

P. Focal length of the lens--The actual distance from the lens to a point behind the lens where light rays are focused when the distance scale is set on infinity. (The distance from the optical center of the lens to the film.)

Q. Shutter--The device which controls the time that the film will be exposed to light.

  1. Leaf Shutter--Thin pieces of metal which open and close on a hinged, spring-loaded system.

  2. Focal Plane Shutter--Two opaque cloth or metal foil curtains separated by a narrow slit.

R. Focusing screens--A device which helps the photographer tell if his picture is in focus.

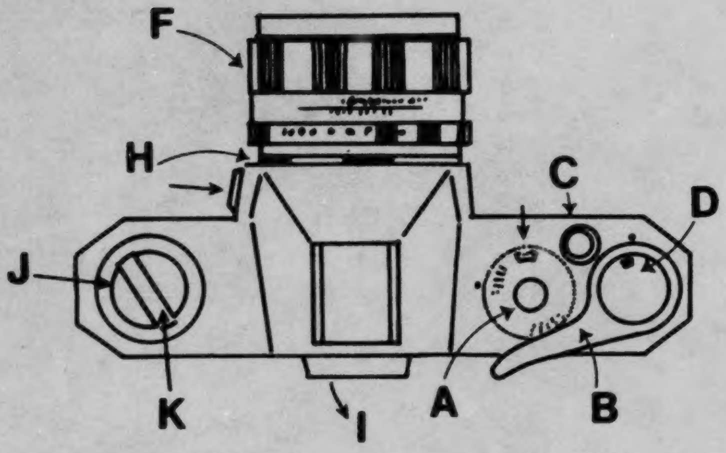
  1. Split image--Image is divided when out of focus.

  2. Grids--Shows area as being very out of focus when only slightly out of focus.

S. Flash synchronization--The setting of the shutter speed that makes the shutter opening speed and flash duration equal. Marked by an X and the shutter speed dial.

T. Electronic flash--A battery powered lighting device used to provide more light in poorly lit photographic situations.

PARTS OF THE CAMERA



A. SHUTTER SPEED DIAL

B. ADVANCE LEVER

C. SHUTTER RELEASE

D. AUTOMATIC RESET EXPOSURE COUNTER

E. SELF-TIMER COCKING LEVER

F. FOCUSING RING

G. FLASH TERMINAL

H. PREVIEW LEVER

I. VIEWFINDER

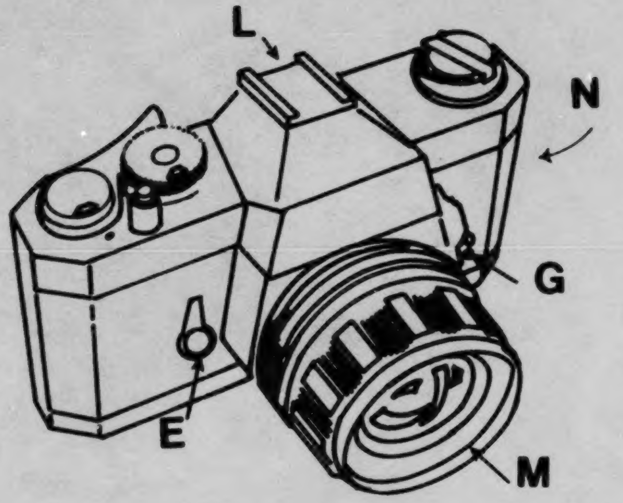
J. REWIND KNOB

K. REWIND CRANK

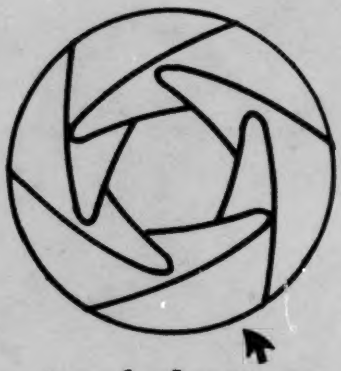
L. HOT SHOE

M. LENS

N. BODY

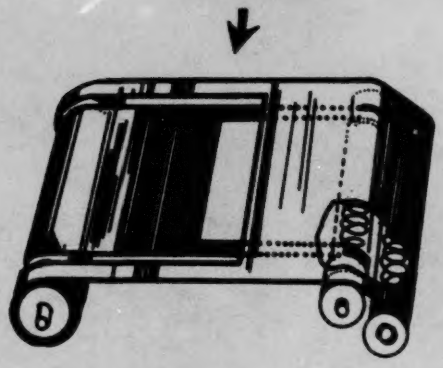


SHUTTER TYPES

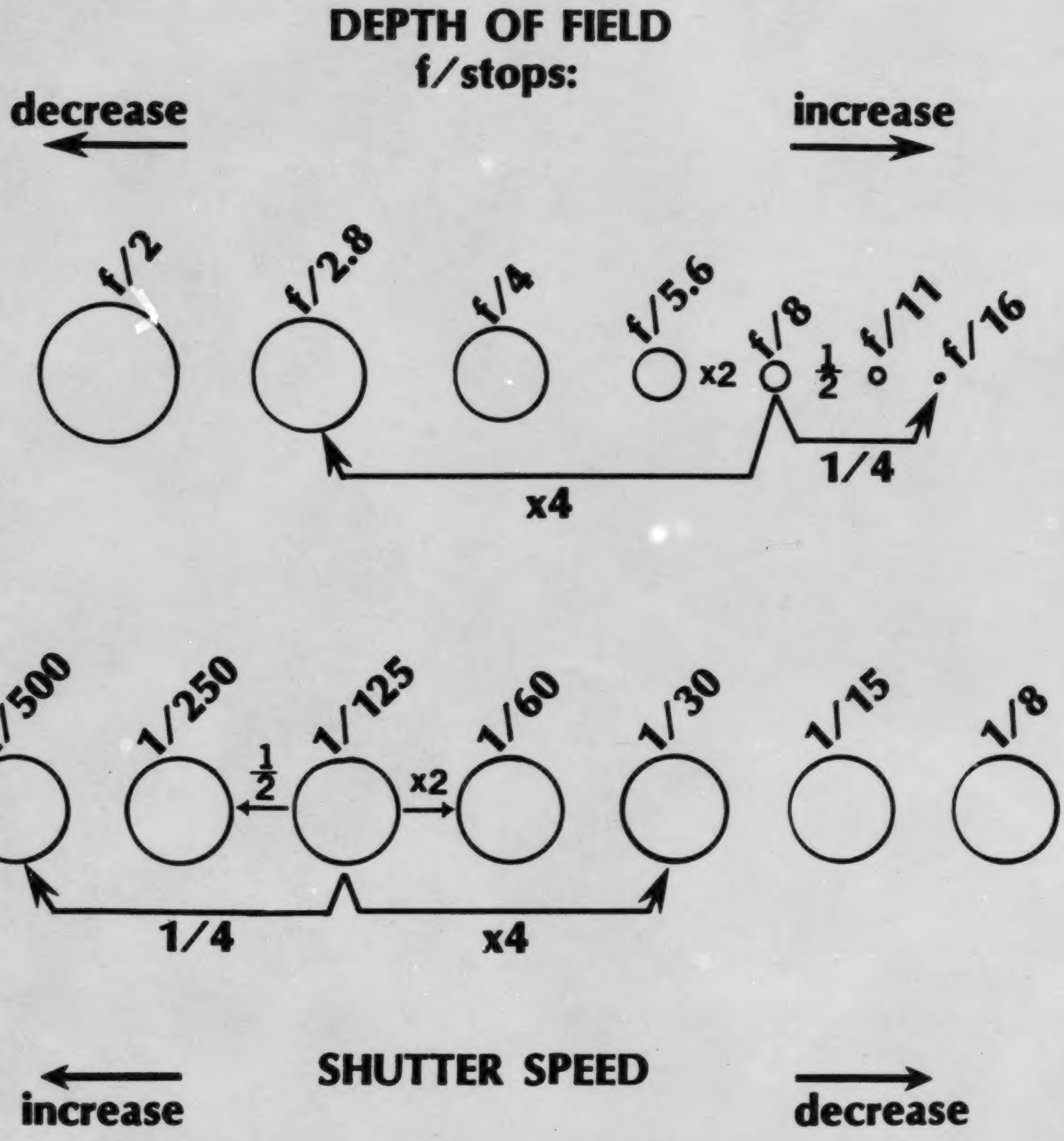


Leaf shutter

Focal plane shutter



SHUTTER SPEED--LENS OPENING


DEPTH OF FIELD
f/stops:
decrease
increase
f/2
f/2.8
f/4
f/5.6
x2
f/8
½
f/11
f/16
1/4
x4
1/500
1/250
½
1/125
x2
1/60
1/30
1/15
1/8
1/4
x4
SHUTTER SPEED
increase
decrease

PINHOLE CAMERA

Materials:

1 Cartridge of 126 Film--Kodak Tri-X Pan

1 Piece of thin black cardboard 1 1/4" X 5 3/4"

1 Piece of rigid black cardboard, 1 1/2" X 2 3/4", with a 1/2" square opening cut in center

1 Piece of heavy aluminum foil, 1 inch square

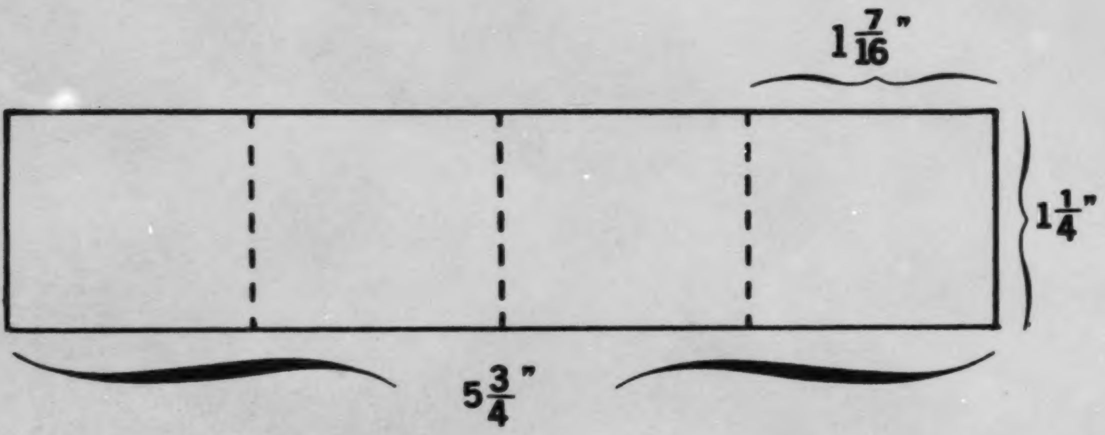
1 Piece of black paper, 1 inch square

1 Wooden tongue depressor

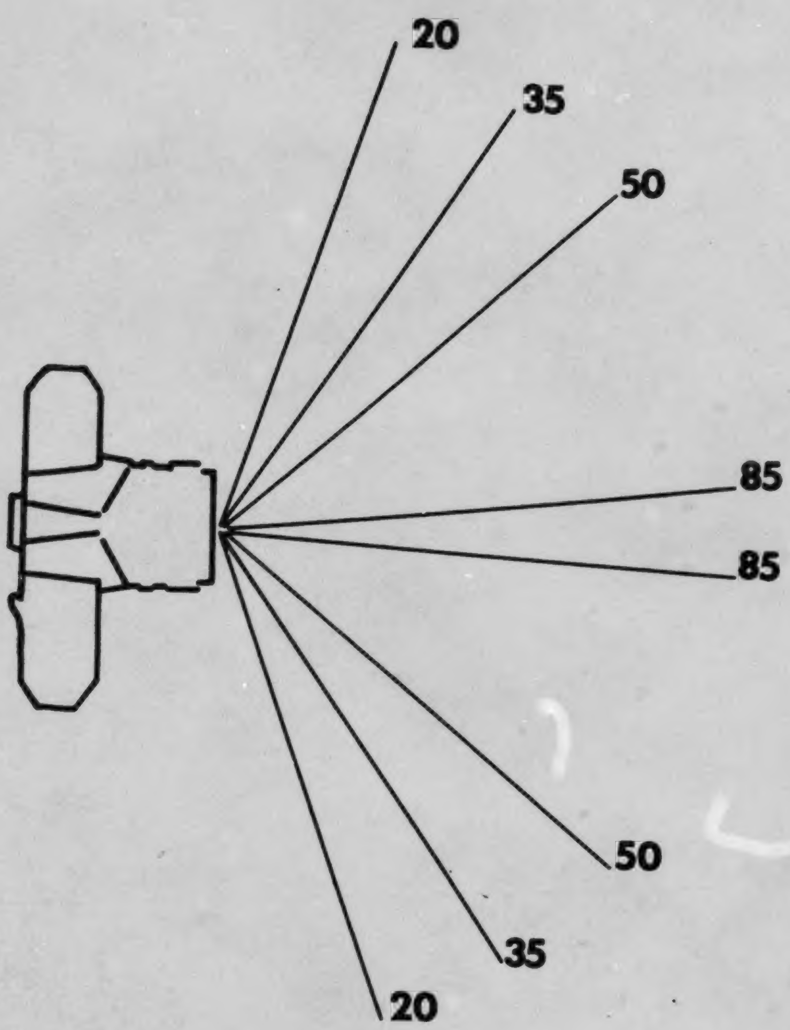
2 Strong rubber bands

1 No. 10 sewing needle

Black masking tape

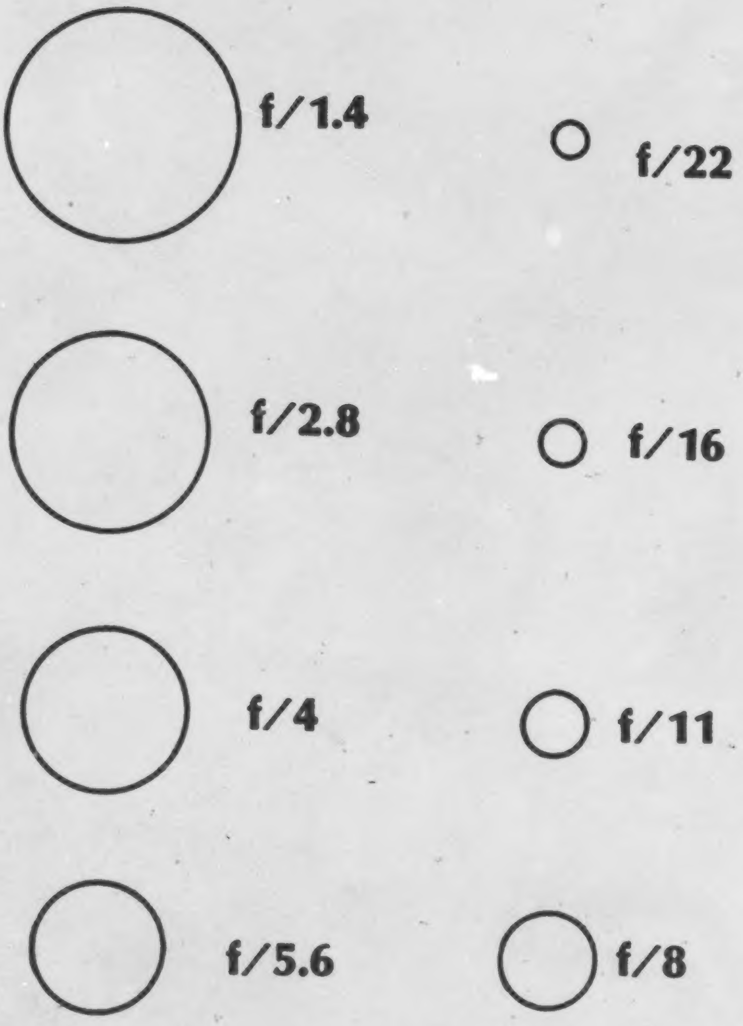


VIEWING ANGLES


20
35
50
85
85
50
35
20

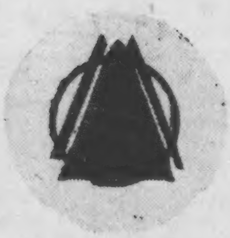
LENS OPENING SIZES

f/STOP OPENINGS

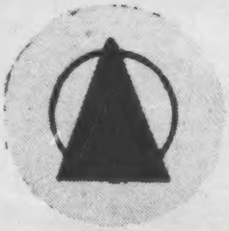

f/1.4
f/22
f/2.8
f/16
f/4
f/11
f/5.6
f/8

Focusing Screens

COINCIDENT

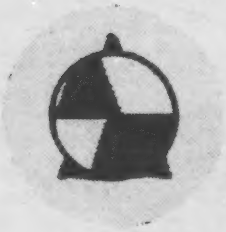


out of focus

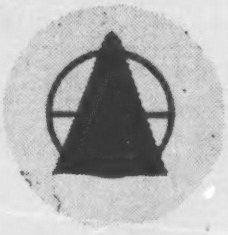


in focus

SPLIT IMAGE



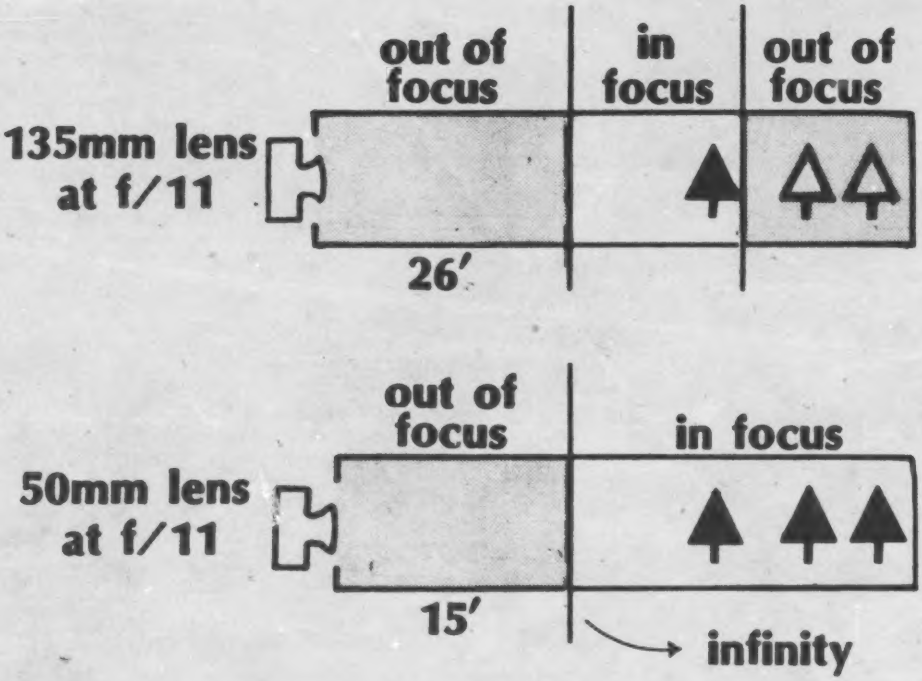
out of focus



in focus

DEPTH OF FIELD

CAMERA FOCUSED AT 30 FEET


out of focus
in focus
out of focus
135mm lens at f/11
26′
out of focus
in focus
50mm lens at f/11
15′
infinity

Demonstration #1

MAKE A PINHOLE CAMERA

Objective

To make a very simple camera to aid students learn about the principles of the camera.

Materials

1 Cartridge of 126 Film, Kodak Tri-X Pan

1 Piece of thin black cardboard, 1 1/4" X 5 3/4"

1 Piece of rigid black cardboard, 1 1/2" X 2 3/4", with a 1/2" square opening cut in center.

1 Piece of heavy aluminum foil, 1 inch square

1 Piece of black paper, 1 inch square

1 Wooden tongue depressor

2 Strong rubber bands

1 No. 10 sewing needle

Black masking tape

1 Utility knife

1 Pair of scissors

Procedure

1. Make four 1 7/16" sections on the large piece of black cardboard.
2. Cut through top layer of the cardboard on each line.
3. Fold the cardboard into a box shape.
4. Place black tape on the corners.
5. Make a hole in the center of the aluminum foil with the point of the needle.

6. Center and tape the foil over the opening in the small piece of cardboard.
7. Tape the small piece of black paper over the foil along the top.
8. Tape the cardboard with the hold to the box.
9. Place the camera against the film cartridge.
10. Secure film with rubber bands.
11. Trim tongue depressor to fit film cartridge to advance film.

Principle

A pinhole camera is a small, lighttight can or box which has its inside painted black. A small hole is punched in the center of one end and the hole is covered to prevent light from hitting the film until the proper time. The hole is aimed at the object to be photographed and the paper over the hole raised allowing the light to strike the film. The light reacts with the silver halides and the film recording the images on the film.

Student Activity #1

Objective

You will take the materials given and correctly complete the following:

(1) construct a pinhole camera, (2) expose the film in the camera, and (3) have the film developed.

Materials

1. 1-Cartridge of 126 Kodak Tri-X Pan film
2. 1-Piece of thin black cardboard, 1 1/4" X 5 3/4"
3. 1-Piece of rigid black cardboard, 1 1/2" X 2 3/4" with a 1/2" square opening in the center.
4. 1-Piece of heavy aluminum foil, 1 inch square
5. 1-Piece of black paper, 1 inch square
6. 1-Wooden tongue depressor
7. 2-Rubber bands
8. Black masking tape
9. No. 10 sewing needle
10. Utility knife
11. Scissors

Procedure--Construct a Pinhole Camera

1. Make four 1 7/16" sections on the large piece of black cardboard.
2. Cut through top layer of the cardboard on each line.
3. Fold the cardboard into a box shape.
4. Place black tape on the corners.
5. Make a hole in the center of the aluminum foil with the point of the needle.
6. Center and tape the foil over the opening in the small piece of cardboard.

6. Center and tape the foil over the opening in the small piece of cardboard.
7. Tape the small piece of black paper over the foil along the top.
8. Tape the cardboard with the hold to the box.
9. Place the camera against the film cartridge.
10. Secure film with rubber bands.
11. Trim tongue depressor to fit film cartridge to advance film.

Procedure--Expose the Film in the Camera

1. Point the end of the camera with the hole in it toward object or subject.
2. To properly aim the camera sight over the top of the camera.
3. The camera must be held very still. Support the camera on a table, chair, rack, etc.
4. Lift the cover that is over the hole to expose the film.
5. The exposure time is: In light sun--1/2 to 1 second, Cloudy bright--2 to 4 seconds.
6. To get a good picture take three pictures of each scene.
7. Make one picture at the recommended exposure time, one at twice the time and one at one-half the recommended time.
8. After each exposure lower the cover over the hole and hold tightly until you make the next exposure.

Procedure--Have Film Developed

1. Remove film from camera.
2. Take exposed film cartridge to be developed.

Activity Sheet #2

TAKING PICTURES

I. Tools and Materials

A. Tools

1. 35mm SLR camera with normal lens
2. Electronic flash
3. Tripod
4. Shutter release cable
5. 36 exposure roll of black and white film

B. Materials

1. Lens cleaning fluid
2. Lens cleaning tissue

II. Procedure

1. Secure tools
2. Buy proper type of film
3. Load film into camera
4. Shoot pictures using the procedures and tools best suited to that situation
5. Unload film after completing the 36 exposures
6. Have film developed

PH 3.14

TEST 1

Match the terms on the right to the correct definition or description.

_____ 1. The focus area of a camera.

_____ 2. The device which controls the time that the film will be exposed to light.

_____ 3. A battery powered lighting device used to provide more light in a poorly lit photographic situation.

_____ 4. The size of the lens opening.

_____ 5. The glass opening which reduces the image to film size and produces a clear and sharp picture on the film.

_____ 6. That part of the camera that holds the film and has the other parts of the camera attached.

_____ 7. Shows how many pictures have been taken.

_____ 8. A button which controls the lens and allows the scene to be seen as it looks at a particular F-stop setting.

_____ 9. Shows the image that is seen by the lens of the camera.

____ 10. A device which helps the photographer tell if his picture is in focus.

____ 11. The holding device for the electronic flash.

____ 12. The lever which controls the movement of film from exposed to unexposed.

____ 13. This lens brings images in closer.

____ 14. This lens makes scenes, objects, and rooms stretch out to infinity.

____ 15. A device which allows a time period to elapse between the time the shutter button is pushed and the picture taken.

A. Electronic flash

B. F-stop

C. Body

D. Depth of field preview button

E. Focusing Screen

F. Advance Lever

G. Wide Angle

H. Depth of Field

I. Shutter

J. Lens

K. Frame Counter

L. Viewfinder

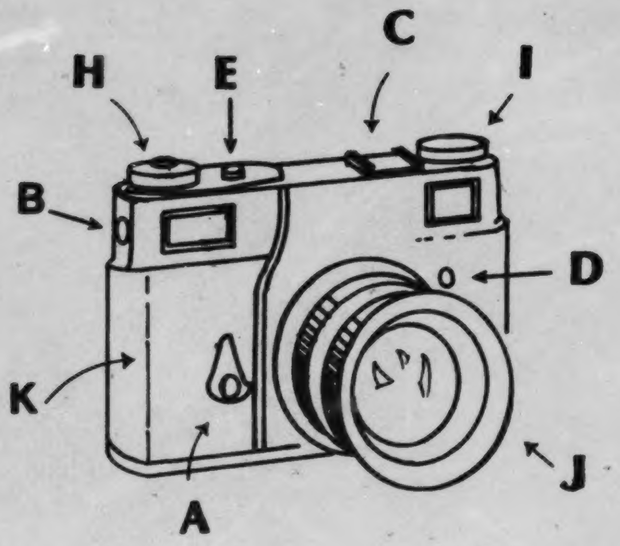
M. Hot Shoe

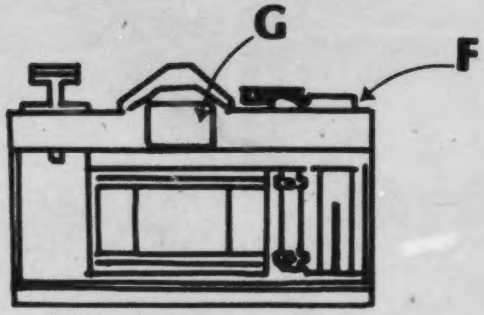
N. Telephoto

O. Timer

TEST 2

Identify the parts of the camera on the following picture:





A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________

F. ____________________

G. ____________________

H. ____________________

I. ____________________

J. ____________________

ANSWERS TO TEST

TEST 1

1. H
2. I
3. A
4. B
5. J
6. C
7. K
8. D
9. L
10. E
11. M
12. F
13. N
14. G
15. O

TEST 2

A. Self timer cocking lever

B. Flash terminal

C. Hot shoe

D. Preview button

E. Shutter release

F. Film advance lever

G. Viewfinder

H. Shutter speed dial

I. Rewind knob

J. Lens

K. Body

EQUIPMENT/SUPPLIES

I. Equipment

   A. 12--utility knives

   B. 12--Pairs of scissors

   C. 02--35 mm SLR Cameras

   D. 02--Electronic flashes

   E. 02--Tripods

   F. 02--Light meters

   G. 02--Shutter release cables

II. Supplies

   A. 12--Cartridge of 126 Film, Kodak Tri-X Pan

   B. 12--Pieces of thin black cardboard, 1 1/4" X 5 3/4"

   C. 12--Pieces of rigid black cardboard, 1 1/2" X 2 3/4" with a 1/2" square opening cut in center.

   D. 12--Pieces of heavy aluminum foil, 1 inch square.

   E. 12--Pieces of black paper, 1 inch square.

   F. 12--Wooden tongue depressors.

   G. 24--Strong rubber bands.

   H. 12--No. 10 sewing needles

   I. 1--Roll of black masking tape

   J. 4--Bottles of lens cleaning fluid

   K. 4--Packages of lens cleaning tissue

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

TYPES OF BLACK AND WHITE FILM

DESCRIPTION OF UNIT

This unit covers the common types of .35 mm black and white film. The basic characteristics of each film is discussed. The materials in this unit are designed for 2 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to list the most common types of black and white film and list the characteristics of each. The student will be able to match the terms related to film to their definition.

PERFORMANCE OBJECTIVES

After completion of the unit the student will be able to:

1. Match the type of black and white film with its characteristics.
2. Match terms associated with film to their definitions.
3. Demonstrate the ability to:
    - A. Select the proper black and white film to achieve desired results.
    - B. Predict picture appearance when certain film is used.
    - C. Describe what film is and give a brief history of it.

OUTLINE OF CONTENT

I. What is film?

Definition - Film is a light-sensitive material that is made up of grains of silver halides suspended in gelatin and coated with an acetate. (See TM #1)

A. Silver halides - Silver grains combined with a halogen element for increased sensitivity.

B. Emulsion - Silver halides suspended in gelatin.

C. Acetate - The plastic base of film.

II. How does film work?

A. Light strikes film.

B. Silver halide turns to shades of gray and then black depending on the amount of light striking the film.

C. The brightest light creates the blackest, silver-halide crystals.

D. Negative effect is reversed because bright areas turn black and black areas in the scene remain clear.

E. Antihalation Dye - The film coating that keeps the rays of light that pass through the emulsion from being reflected back into the emulsion after they have passed through.

III. Film Size

A. 110 and 126 - Usually in light, tight plastic cassette in which unexposed film is in one compartment. As film is exposed it is rolled into the other compartment. Entire cassette is sent to be developed.

B. 135 usually called 35 mm - Comes in cassette form but most commonly comes in a roll which must be threaded into camera. Film is rolled back into spool after it is exposed.

IV. Contrast - Demo #1 shows examples of contrast.

A. The elimination of some grays of a picture because the film has less clumps of light-sensitive material.

B. A picture taken with high-speed film has fewer tones.

C. The slower the film speed the more gray tones that will show up.

V. Film Speed

Definition - The amount of light needed to make a quality picture on a type of film.

A. ASA - The number giving the speed of the film.

1. Higher ASA number the faster the film.

2. Films with high ASA numbers will work in low light areas.

3. The films with high ASA numbers do not produce quality as good as slower speeds.

B. The faster the film speed, the poorer the picture quality.

VI. Grain - Demo #2 show enlarged pictures

A. Caused by clumps of light-sensitive material in the emulsion.

B. Large spaces between the clumps cause all clumps to react to light coming in contact with the emulsion because they are far apart and not hidden beneath each other.

D. When negatives are enlarged the spaces become more evident.

VII. Types of film

A. Panatomic - X

1. Speed - ASA 32

2. High Contrast

3. Fine Grain

B. Plus - X Pan

1. Speed - ASA 125

2. Good Contrast

3. Fine Grain

C. Tri-X Pan

1. Speed - ASA 400

2. Good Contrast

3. Coarse Grain

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through outline of content giving demonstrations as you go.

IV. Discuss student activity sheets.

V. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Take test.

REFERENCES/RESOURCES

I. References

A. Gerace, Philip G.; and Mangiane, Stephen S., Communication: Photography, Met Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1976.

B. Muse, Ken., Photo One, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

II. Resources

A. Information Sheets.

B. Activity Sheets.

C. Demonstrations.

D. Transparency Masters.

Information Sheet #1

I. Terms and Definitions

Film - A light-sensitive material made of grains of silver halides suspended in gelatin and coated onto an acetate strip.

Film leader - A length of protective film at the beginning of a roll of film.

Film speed - The sensitivity of a given film to light, indicated by a number; the higher the number, the more sensitive, or "faster", the film.

Silver halides - Silver grains combined with a halogen element.

Emulsion - A thin coating of light-sensitive material, usually silver halide in gelatin, in which the image is formed on film and photographic papers.

Acetate - The plastic base of film which carries the emulsion.

ASA - The number giving the speed of the film.

Graininess - The sand-like or granular appearance of a negative, print, or ASA slide resulting from the clumping of silver grains during development of the film; graininess becomes more pronounced with faster films, increased density in the negative, and degree of enlargement.

Contrast - The density range of a negative, print or slide; the brightness range of a subject or the scene lighting.

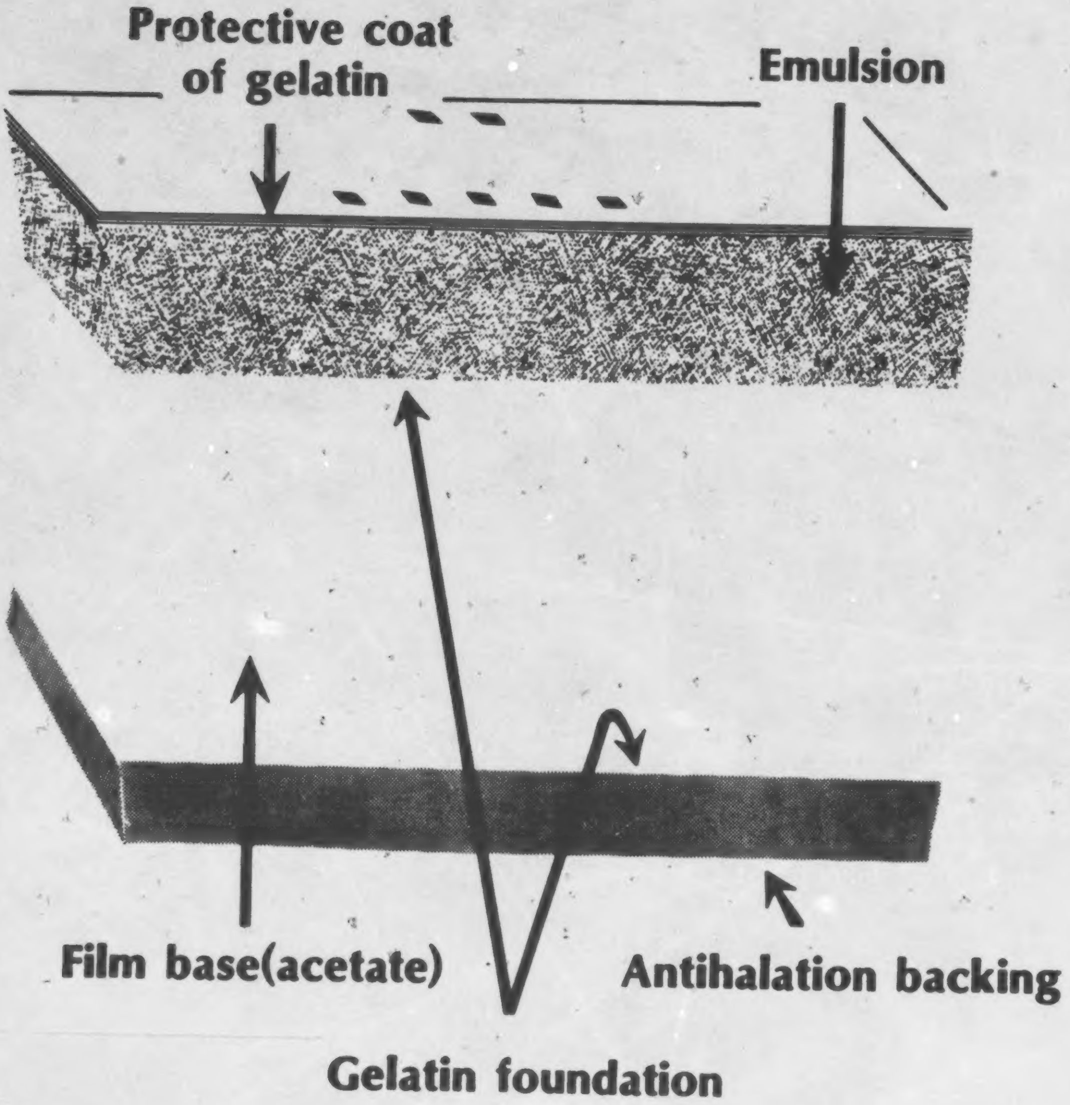
Negative - The developed film that contains a reversed image of the original object or scene.

Positive - An image with the same object or scene relationship as the original object or scene.

Tone - The degree of lightness or darkness in an area of a picture.

PHOTOGRAPHIC FILM

(ENLARGED)


Protective coat of gelatin
Emulsion
Film base(acetate)
Antihalation backing
Gelatin foundation

Demonstration #1

Objective:

To show students the difference in contrast as shown by enlargements of different pictures made of the same object made with different speeds.

Materials:

1. Enlargement of Panatomic - X pictures.
2. Enlargements of Plus X Pan pictures.
3. Enlargements of Tri - X Pan pictures.

Procedure:

Have the students examine each of the pictures made with each type of film. Discuss the pictures and the qualities of each.

Principle:

The faster films produce more contrast. The contrast of a picture is the elimination of the grays in the pictures. Fewer shades of gray are present because fewer clumps of light-sensitive materials are present. Fewer tones are present in high speed film and more tones are present in slower speed film.

Demonstration #2

Objective:

To show students what happens to the clarity of pictures made with the three different types of film when they are enlarged. Students should see large dots on the enlargements.

Materials:

1. Enlargement of a Panatonic X film.

2. Enlargement of Plus X Pan film.

3. Enlargement of Tri X Pan film.

Procedure:

Have the students examine each picture made with each type of film. Discuss the pictures and the qualities of each.

Principle:

The Tri X Pan film will have large black dots when enlarged. Panatomic X and Plus X Pan are fine grain films and when they are enlarged do not show large dots.

Student Activity #1

Objective:

You will take pictures using each of the three types of black and white film. Each picture will be enlarged so the students will better see the characteristics of each type of film. Students will develop the film in a later class.

Materials:

1. 1 - 35 mm SLR Camera.
2. 1 - Roll of Panatomic - X film.
3. 1 - Roll of Plus - X Pan film.
4. 1 - Roll of Tri - X Pan film.

TEST 1

Match the following terms to their definition.

1. _____ Silver grains combined with a halogen element.
2. _____ A length of protective film at the beginning of a roll of film.
3. _____ The degree of lightness or darkness in an area of a picture.
4. _____ A light-sensitive material made of grains of silver halides suspended in gelatin and coated onto an acetate strip.
5. _____ The number giving the speed of its film.
6. _____ The density range of a negative, print, or slide; the brightness range of a subject or the scene lighting.
7. _____ A thin coating of light-sensitive material, usually a silver halide in gelatin in which the image is formed on film.
8. _____ The plastic base of film which carries the emulsion.
9. _____ The developed film that contains a reversed image of the original object or scene.
10. _____ The sand-like or granular appearance of a negative, print, or slide resulting from the clumping of silver grains during development of the film.

A. ASA

B. Contrast

C. Film

D. Film leader

E. Emulsion

F. Acetate

G. Tone

H. Silver halides

I. Graininess

J. Negative

TEST #2

Match the film name to the proper characteristics.

1. Speed - ASA 400
   Good Contrast
   Coarse Grain ________

2. Speed - ASA 32
   High Contrast
   Fine Grain ________

3. Speed - ASA 125
   Good Contrast
   Fine Grain ________

A. Panatomic - X

B. Tri - X Pan

C. Plus - X Pan

ANSWERS TO TEST #1

1. H
2. D
3. G
4. C
5. A
6. B
7. E
8. F
9. J
10. I

ANSWERS TO TEST #2

1. B
2. A
3. C

EQUIPMENT/SUPPLIES

I. Equipment

- A. 02 - 35 mm SLR cameras.
- B. 02 - Electronic flashes.
- C. 02 - Tripods.
- D. 02 - Light meters.
- E. 02 - Shutter release cables.

II. Supplies

- A. 06 rolls of Panatomic - X film.
- B. 06 rolls of Plus - X Pan film.
- C. 06 rolls of Tri - X Pan film.

COMMUNICATIONS

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

PHOTOGRAPHY

Title of Unit:

DEVELOPING BLACK AND WHITE FILM

DESCRIPTION OF UNIT

This unit will cover basic techniques used in developing black and white film. It will give an overview of the following areas: the process used to develop black and white film, the chemicals used to develop film, and the basic purposes of the chemicals used. The materials in this unit are designed for 8 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to name and give the function of each of the chemicals used to develop black and white film, explain the developing process step by step identify the tools and equipment, and know the meaning of the terms used with the developing process. The student will also demonstrate the ability to develop black and white film by using the proper chemicals and equipment.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match terms associated with film developing to the correct definition or description.
2. List and describe the basic chemicals used to develop black and white film and give each one's function.
3. Identify the tools and equipment used in developing and tell what they are used for.
4. Briefly list in order the steps used in developing black and white film.

5. Demonstrate the ability to:

   A. Set up the chemicals and equipment to develop film.

   B. Develop black and white film.

   C. Properly mix all chemicals needed to develop film.

   D. Properly use all equipment found in the black and white darkroom.

OUTLINE OF CONTENT

I. Chemicals

A. Developer

The emulsion side of the film is hit by the light as it enters the lens of the camera. The developer reacts chemically with the film emulsion during the processing of the exposed film. The film will range from black to white once it has been developed since different areas of the film received different amounts of light. Images that have been created on the film are the opposite of the original scene. Dark areas of the scene appear as light areas on the film. This is the reason developed film is called a negative.

B. Stop Bath

Stop bath is another chemical used to stop the chemical reaction of the developer. The stop bath is diluted acid and should be worked with carefully.

C. Fixer

Although the reaction between the developer and the film is stopped after it is placed in the stop bath, the film can still react to light because part of the emulsion on the film was not affected by the light during the first exposure. The negative will be ruined by being turned black by the emulsion being exposed to more light. The fixer is another chemical solution used to prevent the emulsion from being affected by light. The fixing solution contains chemicals that will remove the unused emulsion so that the negative will no longer be sensitive to light. The fixing solution also contains chemicals that help to harden the film which has become soft during developing. The fixer makes the negative more durable and harder to scratch.

II. Steps in Developing Roll Film

NOTE: Temperature of solutions and developing time are the most important factors affecting good negative processing. The best developing temperature is 68 degrees. The developer water and hypo should all be the same temperature. The temperature is important and should be carefully maintained at the same level. The warmer the developer the more rapidly it works. The temperature of the developer can be raised by handling too much.

The rate of development is controlled by time, temperature, and agitation. The effects of each are figured into film development for "predictable" results. Follow your directions carefully.

A. Half-fill a large jar or pitcher with lukewarm water. Check the temperature with a thermometer and add the proper amounts of cool or warm water until it has stabilized at 68°F (20°C) for at least one (1) full minute.

B. Mix the developer according to the instructions packaged with it. Pour the proper amount into the developing tank and the rest into a jar labeled Developer.

C. Mix the stop bath according to the instructions packaged with it. Pour it into a jar labeled Stop Bath.

D. Mix the fixer according to the instructions packaged with it. Pour it into a jar labeled Fixer.

E. In total darkness remove the film from the film cartridge. Detach the film and discard the paper and tape that has been around the film. Handle the film by the edges only.

F. While handling the film by its edges, roll the film into the apron or reel according to the tank instruction. Put the reel or apron into the tank, secure the lid, and start timing. Room lights may be turned on.

G. Remove any air bubbles by tapping the tank against the working surfaces. Agitate the tank by inverting it, rotating it in a circular motion or rotating the reels. Agitate for five (5) seconds at thirty (30) second intervals. When the developing time is over, pour the solution back into the developer jar.

H. Pour the stop bath solution into the tank through the opening in the top. do not open the tank. Agitate gently for thirty (30) seconds, and then pour the liquid back into its original jar.

I. Add the fixer solution and agitate as before. At the end of the fixing time (2 to 4 minutes with Kodafix Solution--5 to 10 minutes with Kodak Fixer), pour the solution into its jar.

J. Open the tank and inspect the film for the following defects in processing:

1. Beige spots - Film improperly loaded so that it stuck together in the reel, preventing the chemicals from reaching the surface of the emulsion. Return to hypo and agitate until the affected area is transparent.

2. Pinkish tinge - Insufficient agitation. This is residue from the anti-halation backing. Return to hypo and agitate until film clears. Note: Tri-X is difficult to clear. Fix until "pink" is as faint as possible. Kodak claims the tint will not interfere with printing and may disappear on exposure to light.

3. Overall cloudiness - Contaminated, weakened, or exhausted fixer. Check strength of hypo and replace it if necessary. Return film to tank, protect against light until you can get fresh hypo and repeat the fixing procedure.

K. Remove the tank cover, place the tank under a moderate stream of 65 to 75° F water, and let the film wash for about a half hour. To shorten washing time, rinse the film in Kodak Hypo Clearing Agent. Then you wash for 5 minutes.

L. Hang up the film with a film clip at each end. Dampen a viscous sponge, wring it out, and then gently run it along both sides of the film to remove large droplets of water. Let the film dry. Don't forget to rinse out all parts of your film tank.

M. Identify the negative envelope with your name, the subject matter, and date before inserting film. Cut negatives in strips: 2 1/4" X 2 1/4" frames, or five 35 mm frames. Keep negatives protected in the envelope at all times except when in use.

I

II. Each step of the developing procedure should be carefully explained and demonstrated by the instructor.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss information sheets and go through outline of material, giving demonstrations as you go.

V. Discuss student activity sheets.

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheets.

IV. Take test.

REFERENCES/RESOURCES

I. References

A. Basic Developing, Printing, Enlarging in Black and White, Eastman Kodak Company #AJ-2, Consumer Markets Division, Rochester, New York: 1977.

B. CBIE Project, Industrial Education Visual Communication Revised, Kansas State Department of Education, Wichita, Kansas.

C. Gerace, Philip G.; Mangione, Stephen S., Communication: Photography, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

D. Muse, Ken, Photo One, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1973.

II. Resources

A. Information Sheet

B. Activity Sheets

C. Demonstrations

Information Sheet #1

I. Terms and Definitions

Agitation - Keeping the developer, stop bath or fixer in gentle motion while processing film or paper. Agitation helps to speed and ensure even development and prevent spotting or staining.

Clearing agent - A chemical that neutralizes hypo on film or paper, reducing washing time and helping to provide a more stable image.

Darkroom - A light tight area used for processing films and for printing and processing papers; also for loading and unloading film holders and some cameras.

Densitometer - An instrument for measuring the density of an area in a negative or print.

Density - The blackness of an area in a negative or print which determines the amount of light that will pass through it or reflect from it.

Developer - A solution used to turn the latent image into a visible image on exposed film or photographic paper.

Developing tank - A light tight container used for processing film.

Emulsion - The thin coating of gelatin containing silver halides on photographic film or paper.

Emulsion side - The side of the film coated with emulsion. In the contact printing and enlarging, the emulsion side--dull side--of the film should face the emulsion side--shiny side--of the photographic paper.

Etching - Scraping black spots off a print or negative with a special knife.

Film leader - A length of protective film at the beginning of a roll of unexposed or processed film.

Fixing bath - A solution that removes any light sensitive salt not acted upon by light or developer leaving a black-and-white negative or print unalterable by further action of light.

Flat - Too low in contrast the range in density in a negative or print is too short.

Flat lighting - Lighting that produces very little contrast or modeling on the subject with a minimum of shadows.

Fogging - Darkening or discoloring of a negative or print or lightening or discoloring of a slide caused by (1) exposure to non-image-forming light to which the photographic material is sensitive, (2) too much handling in air during development, (3) overdevelopment, (4) outdated film or paper, or (5) storage of film or paper in a hot humid place.

Forced development - Increasing the development time of a film to increase its effective speed (ASA) for low-light situations; push processing.

Graininess - The sand-like or granular appearance of a negative, print or slide resulting from the clumping of silver grains during development of the film.

High contrast - A wide range of density in a print or negative.

Highlights - The brightest areas of a subject and the corresponding areas in a negative.

Hypo - The name for a fixing bath made from sodium thiosulfate, other chemicals, and water.

Latant image - The invisible image left by the action of light on photographic film or paper. When processed, the latent image becomes the visible image either in reversed tones, as in a negative, or in positive tones, as in a color transparency.

Negative - The developed film that contains a reversed-tone image of the original scene.

Positive - The opposite of a negative, an image with the same tonal relationships as those in the original scene.

Reticulation - Cracking or distorting of the emulsion during processing, usually caused by wide temperature or chemical-acting differences between the solutions.

Retouching - Altering a print or negative after development by use of dyes or pencils to alter tones of highlights, shadows, and other details, or to remove blemishes.

Safelight - An enclosed darkroom lamp fitted with a filter to screen out light rays to which film and paper are sensitive.

Stain - Discolored areas on film or paper, usually caused by contaminated developing solution or by insufficient fixing, washing, or agitation.

Stop bath - An acid rinse, usually a weak solution of acetic acid, used as a second step when developing black-and-white film or paper; it stops development and makes the hypo last longer.

Thin negative - A negative that is underexposed or underdeveloped (or both); a thin negative appears less dense than a normal negative.

Underexposed - A condition in which too little light reaches the film, producing a thin negative.

Replenisher - A chemical solution that increases the life of other chemical solutions when it is added to them.

II. Problems Encountered with Negative Development

Streaky Negatives - Due to uneven development. Not all of the film was in contact with the developer during development time or there was not enough solution.

Rows of Regularly Spaced Marks - If they occur inside the picture area of the negative, it's because the film wasn't properly seated in the apron or because the wrong apron was used.

Black Streaks - A sign that light reached the film while the film was being loaded or unloaded into or out of the camera. If all the streaks are on the same side, the top of the developing tank may have loosened during processing.

Overall Grayness - Caused by light sneaking into the darkroom during the time film was being loaded into the developing tank.

Thin Transparent Negatives - If there are no really dark black areas in the entire negative, it usually means that your developer was too cold, you cut short the developing time, or the negative was over exposed.

Dense, Heavy Negatives - The developer was too warm, the film developed too long, or the negative overexposed.

Steps in Developing Roll Film

NOTE: Temperature of solutions and developing time are one of the most important factors affecting good negative processing. The best developing temperature is 68 degrees. The developer water and hypo should all be the same temperature. The temperature is important and should be carefully maintained at the same level. The warmer the developer the more rapidly it works. The temperature of the developer can be raised by handling too much.

The rate of development is controlled by time, temperature, and agitation. The effects of each are figured into film development for "predictable" results. Follow your directions carefully.

A. Half-fill a large jar or pitcher with lukewarm water. Check the temperature with a thermometer and add the proper amounts of cool or warm water until it has stabilized at 68°F (20°C) for at least one (1) full minute.

B. Mix the developer according to the instructions packaged with it. Pour the proper amount into the developing tank and the rest into a jar labeled Developer.

C. Mix the stop bath according to the instructions packaged with it. Pour it into a jar labeled Stop Bath.

D. Mix the fixer according to the instructions packaged with it. Pour it into a jar labeled Fixer.

E. In total darkness remove the film from the film cartridge. Detach the film and discard the paper and tape that has been around the film. Handle the film by the edges only.

F. While handling the film by its edges, roll the film into the apron or reel according to the tank instruction. Put the reel or apron into the tank, secure the lid, and start timing. Room lights may be turned on.

G. Remove any air bubbles by tapping the tank against the working surfaces. Agitate the tank by inverting it, rotating it in a circular motion or rotating the reels. Agitate for five (5) seconds at thirty (30) second intervals. When the developing

H. Pour the stop bath solution into the tank through the opening in the top. do not open the tank. Agitate gently for thirty (30) seconds, and then pour the liquid back into its original jar.

I. Add the fixer solution and agitate as before. At the end of the fixing time (2 to 4 minutes with Kodafix Solution--5 to 10 minutes with Kodak Fixer), pour the solution into its jar.

J. Open the tank and inspect the film for the following defects in processing:

1. Beige spots - Film improperly loaded so that it stuck together in the reel, preventing the chemicals from reaching the surface of the emulsion. Return to hypo and agitate until the affected area is transparent.

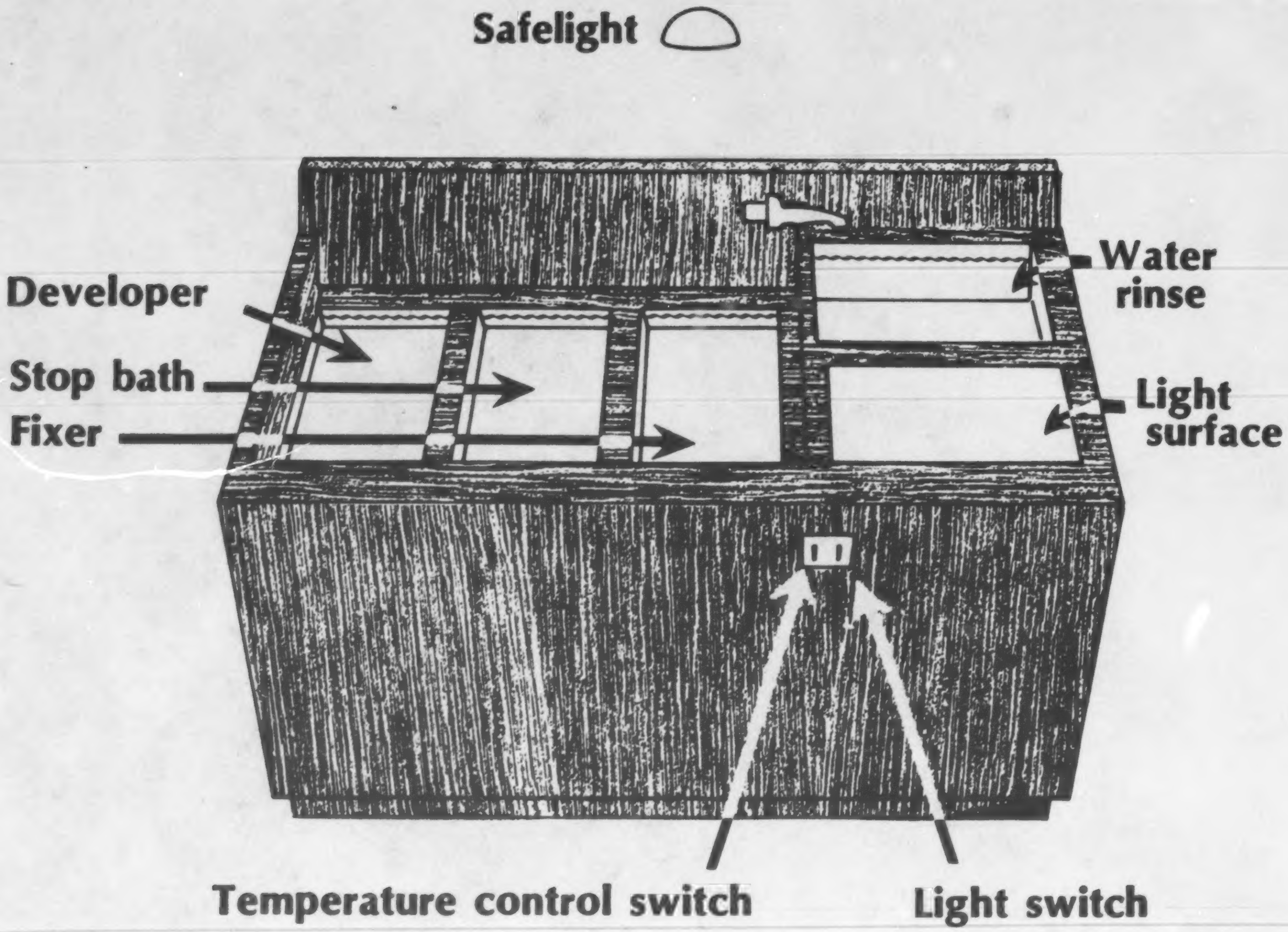
2. Pinkish tinge - Insufficient agitation. This is residue from the anti-halation backing. Return to hypo and agitate until film clears. Note: Tri-X is difficult to clear. Fix until "pink" is as faint as possible. Kodak claims the tint will not interfere with printing and may disappear on exposure to light.

3. Overall cloudiness - Contaminated, weakened, or exhausted fixer. Check strength of hypo and replace it if necessary. Return film to tank, protect against light until you can get fresh hypo and repeat the fixing procedure.

K. Remove the tank cover, place the tank under a moderate stream of 65 to 75° F water, and let the film wsh for about a half hour. To shorten washing time, rinse the film in Kodak Hypo Clearing Agent. Then you wash for 5 minutes.

L. Hang up the film with a film clip at each end. Dampen a viscase sponge, wring it out, and then gently run it along both sides of the film to remove large droplets of water. Let the film dry. Don't forget to rinse out all parts of your film tank.

M. Identify the negative envelope with your name, the subject matter, and date before inserting film. Cut negatives in strips: 2 1/4" X 2 1/4" frames, or five 35 mm frames. Keep negatives protected in the envelope at all times except when in use.


Safelight
Developer
Stop bath
Fixer
Water rinse
Light surface
Temperature control switch
Light switch

Student Activity #1

DEVELOPING BLACK AND WHITE FILM

Objective:

You will take the materials given and process a roll of exposed film into printable negatives. You will also evaluate the finished negatives as to any problems and solutions.

Materials:

1. One roll of exposed 35mm black and white film.
2. One processing tank.
3. One darkroom thermometer.
4. One darkroom graduate.
5. Two spring-type clothespins.
6. Four large jars.
7. One darkroom timer
8. Chemicals: Kodak Developer D-76, Kodak Indicator Stop Bath, and Kodak fixer or KodaFix solution.
9. A stirring rod.
10. Changing bag.

PH 5.15

UNIT TEST

Match the terms on the right to the correct description.

1. The _____ is a solution that removes any light sensitive salt not acted upon by light or developer leaving a black-and-white negative or print unalterable by further action of light.
2. A _____ is a length of protective film at the beginning of a roll of unexposed or processed film.
3. The _____ is a light tight container used for processing film.
4. _____ is a chemical that neutralizes hypo in film or paper, reducing washing time and helping to provide a more stable image.
5. _____ is a fixing bath made from sodium thiosulfate, other chemicals and water.
6. A _____ is developed film that contains a reversed-tone image of the original scene.
7. A _____ is the opposite of a negative, an image with the same tonal relationships as those in the original scene.
8. The _____ is an acid rinse, usually a weak solution of acetic acid, used as a second step when developing black-and-white film or paper.
9. The _____ is the solution used to turn the latent image into a visible image on exposed film or photographic paper.
10. _____ are the lightest areas of density in a print or negative.
11. _____ is the blackness of an area in a negative or print which determines the amount of light that will pass through it or reflect from it.

A. Hypo
B. Film leader
C. Positive
D. Fixing Bath
E. Negative
F. Stop Bath
G. High Contrast
H. Developing Tank
I. Developer
J. Clearing Agent
K. Density

ANSWERS TO TEST

1. D

2. B

3. H

4. J

5. A

6. E

7. C

8. F

9. I

10. G

11. K

EQUIPMENT/SUPPLIES

I. Equipment

- A. 6 processing tanks
- B. 6 darkroom thermometers
- C. 6 darkroom graduates
- D. 24 spring-type clothespins
- E. 8 large jars
- F. 6 darkroom timers
- G. 6 stirring rods
- H. 2 changing bags

II. Supplies

- A. Two gallons of Kodak Developer D-76
- B. Two gallons Kodak Indicator Stop Bath
- C. Two gallons Kodak Fixer or KodaFix solution
- D. 24 rolls of exposed Tri-X-Pan film

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

MAKING PRINTS FROM NEGATIVES

DESCRIPTION OF UNIT

This unit will cover the basic techniques used in contact printing. It will give an overview of the following areas: the darkroom equipment used in contact printing, the functions and working of a contact-printing frame, the various chemicals used in contact printing, and how to make a photogram. The materials in this unit are designed for 10 hours of instruction.

UNIT OBJECTIVE

Upon completion of this unit the student will be able to explain each step in making contact prints, name and give the use of the darkroom equipment used in contact printing, use the contact-print frame correctly, and give the purposes of each of the chemicals used in the printing process. The student will also demonstrate the ability to make quality contact prints by using proper chemicals and equipment.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match terms associated with contact printing to the correct description or definition.
2. List and describe the basic chemicals used in contact printing.
3. Identify the tools and equipment used in contact printing and tell each one's use.
4. Briefly list in order the steps used in contact printing.

5. Demonstrate the ability to:

   A. Set up the chemicals and equipment needed to make a contact print.

   B. Properly mix all chemicals needed to make prints.

   C. Make quality contact prints.

   D. Properly use all equipment used to make contact prints.

OUTLINE OF CONTENT

I. Temperature, time and agitation

A. Temperature of solutions and developing time are the most important factors affecting good contact prints and should be closely monitered.

B. The best temperature for chemicals used in contact printing is 68° F.

C. Developer, water, and hypo should all be the same temperature.

D. The warmer the solutions, the more rapidly it works.

E. Solution temperatures can be raised by handling them too much.

II. Photographic papers

A. Comes in variety of sizes, weights, surfaces, tints, speeds, textures, and contrast grades.

B. Contact printing paper is less sensitive to light than enlarging paper and requires longer exposure time to make a photograph.

C. Paper comes in contrast grades from No. 2 through No. 6.

D. No. 2 contrast paper works best for contact printing.

E. Photographic paper is sensitive to white light and should be handled in a safelight.

F. The sensitive side of the paper is called the emulsion side of the paper.

G. The emulsion side of the paper is smoother to the touch, more shiny than the back, and tends to curl inward.

III. Steps in making a proof sheet

A. Half-fill a large jar or pitcher with lukewarm water. Check the temperature with the thermometer, and then add sufficient cool or warm water until you have it stabilized at 68° F for at least 1 full minute.

B. Mix the developer according to the instructions packaged with it. Pour it into a tray labeled Developer to a depth of about 1/2 inch and then put the rest into a labeled jar.

C. Mix the stop bath according to the instructions; pour about 1/2 inch into a tray labeled Stop Bath and the rest into a labeled jar.

D. Mix the fixer according to the instructions, pour about 1/2 inch into a tray labeled Fixer, and then put the rest into a labeled jar.

E. Arrange the trays in front of you so that, from left to right, you have developer, stop bath, and fixer. Then rinse your hands well and dry them thoroughly. Turn off all lights except the safelight. The safelight should be placed at least 4 feet from your work.

F. Remove one sheet of photographic paper and close the package so light can not get in. Place the negative so the dull side faces the shiny side of the paper. The negatives should be near the light source. Cover with the glass.

G. If a print frame is being used with a 7-watt bulb, hang the bare bulb 2 feet above the frame and turn it on for about 10 seconds. Getting the correct exposure time may require experimentation.

H. If an enlarger is used, place the empty negative carrier in the enlarger and set the lens at F/11. The enlarger should be adjusted so the light covers an area a little larger than the paper. Expose for about 8 seconds. You may have to experiment to get the correct exposure time.

I. Remove the paper from the printing device with your left hand (do not get your right hand wet with developer) and slide the paper into the developer. Make sure shiny side is up. Rock the tray gently for 1 1/2 minutes by tipping up on one end and then the other end.

J. Remove the paper from the developer with your left hand. Let the paper drain for one or two seconds and slide the paper into the stop bath (center tray). Using the same method of agitation as in step I, agitate the tray for 5 to 10 seconds.

K. Remove the paper from the stop bath with your right hand and place the paper into the fixer. Agitate the prints frequently for 2 minutes and keep the prints separate from other prints in the fixing tray. After the prints have been in the fixer for 25-30 seconds, the lights can be turned on.

L. If most of the pictures on the proof sheet seem to be too light, make another proof sheet and double the exposure time used on the first. Cut the exposure time in half if most of the pictures seem too dark. You should keep notes on the exposure time and the results.

M. Wash the print for 4 minutes at 65 to 70° F in the fourth tray. Agitate the print frequently while it is washing while using running wter.

N. Sponge or squeegee the surface water from both sides of the print and place it onto a flat surface to dry at room temperature.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through outline of content.

IV. Demonstrate each step involved in making contact prints stressing each step and the proper procedures of each step.

V. Discuss the student activity sheets.

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Pay attention to and learn the steps and procedures gone over in the demonstrations given in this unit.

IV. Complete activity sheets.

V. Take test.

REFERENCES/RESOURCES

I. References

A. Basic Developing, Printing, Enlarging in Black and White, Eastman Kodak Company #AJ-2 Consumer Markets Division, Rochester, New York: 1977.

B. CBIE Project, Industrial Education Visual Communication Revised, Kansas State Department of Education, Wichita, Kansas.

C. Gerace, Philip G.; Mangione, Stephen S., Communication: Photography, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

D. Muse, Ken, Photo One, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1973.

II. Resources

A. Information Sheets

B. Activity Sheets

C. Demonstrations

Information Sheet #1

I. Temperature, time and agitation

A. Temperature of solutions and developing time are the most important factors affecting good contact prints and should be maintained at all levels.

B. The best temperature for chemicals used in contact printing is 68° F.

C. Developer, water, and hypo should all be the same temperature.

D. The warmer the solutions, the more rapidly it works.

E. Solution temperatures can be raised by handling them too much.

II. Photographic papers

A. Comes in variety of sizes, weights, surfaces, tints, speeds, textures, and contrast grades.

B. Contact printing paper less sensitive to light than enlarging paper and requires longer exposure time to make a photograph.

C. Paper comes in contrast grades from No. 2 through No. 6.

D. No. 2 contrast paper works best for contact printing.

E. Photographic paper is sensitive to white light and should be handled in a safelight.

F. The sensitive side of the paper is called the emulsion side of the paper.

G. The emulsion side of the paper is smoother to the touch, more shiny than the back, and tends to curl inward.

III. Steps in making a proof sheet

A. Half-fill a large jar or pitcher with lukewarm water. Check the temperature with the thermometer, and then add sufficient cool or warm water until you have it stabilized at 68° F for at least 1 full minute.

B. Mix the developer according to the instructions packaged with it. Pour it into a tray labeled Developer to a depth of about 1/2 inch and then put the rest into a labeled jar.

C. Mix the stop bath according to the instructions; pour about 1/2 inch into a tray labeled Stop Bath and the rest into a labeled jar.

D. Mix the fixer according to the instructions, pour about 1/2 inch into a tray labeled Fixer, and then put the rest into a labeled jar.

E. Arrange the trays in front of you so that, from left to right, you have developer, stop bath, and fixer. Then rinse your hands well and dry them thoroughly. Turn off all lights except the safelight. The safelight should be placed at least 4 feet from your work.

F. Remove one sheet of photographic paper and close the package so light can not get in. Place the negative so the dull side faces the shiny side of the paper. The negatives should be near the light source. Cover with the glass.

G. If a print frame is being used with a 7-watt bulb, hang the bare bulb 2 feet above the frame and turn it on for about 10 seconds. Getting the correct exposure time may require experimentation.

H. If an enlarger is used, place the empty negative carrier in the enlarger and set the lens at F/11. The enlarger should be adjusted so the light covers an area a little larger than the paper. Expose for about 8 seconds. You may have to experiment to get the correct exposure time.

I. Remove the paper from the printing device with your left hand (do not get your right hand wet with developer) and slide the paper into the developer. Make sure shiny side is up. Rock the tray gently for 1 1/2 minutes by tipping up on one end and then the other end.

J. Remove the paper from the developer with your left hand. Let the paper drain for one or two seconds and slide the paper into the stop bath (center tray). Using the same method of agitation as in step I, agitate the tray for 5 to 10 seconds.

K. Remove the paper from the stop bath with your right hand and place the paper into the fixer. Agitate the prints frequently for 2 minutes and keep the prints separate from other prints in the fixing tray. After the prints have been in the fixer for 25-30 seconds, the lights can be turned on.

L. If most of the pictures on the proof sheet seem to be too light, make another proof sheet and double the exposure time used on the first. Cut the exposure time in half if most of the pictures seem too dark. You should keep notes on the exposure time and the results.

M. Wash the print for 4 minutes at 65 to 70° F in the fourth tray. Agitate the print frequently while it is washing while using running wter.

N. Sponge or squeegee the surface water from both sides of the print and place it onto a flat surface to dry at room temperature.

Information Sheet #2

Terms and Definitions:

Safelight - The working light source for making photographic prints. The light will not expose the photographic paper.

Contact printing frame - A device that holds the negative and photographic paper together during exposure. The paper is exposed by light from an external light source.

Contact print - A photographic print made by placing the negative and the printing paper in direct contact for exposure. Contact prints are the same size as the negative.

Contrast - The difference between the shades of black and white in a photograph. A high contrast photograph (one with strong blacks, brilliant whites, and only a few mid-tones) is called "contrasty." A low contrast photograph (one with weak, greyish blacks and many mid-tones) is called "flat."

Contrast grade - A number system used to describe the contrast characteristics that are built into photographic enlarging papers. Contrast grades range from 0 to 6. "Normal" paper is number 2. Papers with a number lower than 2 have a low contrast, and are used to make normal contrast prints from high contrast negatives. Papers with numbers higher than 2 have high contrast, and are used to make normal contrast prints from low contrast negatives.

Paper negative - A negative image that is made on paper instead of film.

Photogram - A shadow image made by laying objects on top of photographic paper and exposing it through the objects.

Print - A positive image on photographic paper.

Process - To develop film or paper.

Push - To develop film longer than normal. Pushing effectively increases the speed of film. It also increases the size of the grain and the contrast.

RC Paper - Printing paper with a plastic coating under the emulsion. RC means resin coated.

Soft - An image that is not sharp. A low contrast image.

Test strip - A strip of photographic paper on which trial exposures of varying lengths are made to determine which is the correct exposure.

Variable-contrast paper - A type of photographic printing paper. The contrast of variable-contrast papers can be changed with filters that are calibrated in contrast grades.

Emulsion side - The side of the film coated with emulsion. (In contact printing and enlarging, the emulsion side--dull side--of the film should face the emulsion side--shiny side--of the photographic paper).

Ferrotype plate - A chromium-plated or black-enameled sheet of steel, or mirror-plated glass, used to dry prints to a high-glass finish; the procedure is sometimes defined as "glazing."

Fogging - Darkening or discoloring of a negative or print or lightening or discoloring of a slide caused by (1) exposure to non-image-forming light to which the photographic material is sensitive, (2) too much handling in air during development, (3) overdevelopment, (4) outdated film or paper, or (5) storage of film or paper in a hot, humid place.

Overexposure - A washed out print caused by being exposed to too much light.

Positive - The opposite of a negative; A finished print.

Printing box - A device used for contact printing that consists of a lighttight box with a source of light and a frame to position the negative against the photographic paper in front of the light.

Printing frame - A device used for contact printing that holds a negative against the photographic paper. The paper is exposed by light from an external light source.

Cropping - A portion of the negative area is omitted when printing and enlarging.

Retouching - Altering a print or negative after development by use of dyes or pencils to alter tones of highlights, shadows, and other details, or to remove blemishes.

Spotting - Retouching a processed print with a pencil or brush (with water colors or dyes) to eliminate spots left by dust on the negative.

Stain - Discolored areas on film or paper, usually caused by contaminated developing solutions or by insufficient fixing, washing, or agitation.

Tint - Shades of white in a finished print, controlled by the color of the paper, varying from white to buff.

Tone - The degree of lightness or darkness in any given area of a print.

Toning - Intensifying or changing the tone of a photographic print after processing.

Vignetting - Printing the central area of a picture while shading the edge areas gradually into white.

Diffusing - Softening detail in a print with a diffusion disk or other material that scatters light.

Diffusion disc - A flat glass with a pattern of lines or concentric rings that breaks up and scatters light from an enlarger lens and softens detail in a print.

Student Activity #1

Objective:

You will take the materials given and the negatives you previously developed and complete the following: (1) make a proof sheet from the negatives, (2) evaluate all prints on the proof sheet and discuss ways to improve them, and (3) make a new print of each negative following the suggestions that were made.

Materials:

1. A printing frame and a 7-watt light bulb.
2. Four trays 8 X 10 inches in size (Kodak Duraflex).
3. A stirring rod.
4. A darkroom graduate.
5. Four large jars.
6. Photographic paper (Kodak Polycontrast Rapid RC Paper, 8 X 10 inches).
7. A safelight (Brownie Darkroom Lamp Kit or Kodak Darkroom Lamp with a Kodak Safelight filter OC).
8. Chemicals: (1) Kodak Dektol Developer, (2) Kodak Indicator Stop Bath, (3) Kodak Fixer or Kodafix Solution.
9. Darkroom timer.
10. Rubber Squeegee

Procedure:

A. Half-fill a large jar or pitcher with lukewarm water. Check the temperature with the thermometer, and then add sufficient cool or warm water until you have it stabilized at 68° F for at least 1 full minute.

B. Mix the developer according to the instructions packaged with it. Pour it into a tray labeled Developer to a depth of about 1/2 inch and then put the rest into a labeled jar.

C. Mix the stop bath according to the instructions; pour about 1/2 inch into a tray labeled Stop Bath and the rest into a labeled jar.

D. Mix the fixer according to the instructions, pour about 1/2 inch into a tray labeled Fixer, and then put the rest into a labeled jar.

E. Arrange the trays in front of you so that, from left to right, you have developer, stop bath, and fixer. Then rinse your hands well and dry them thoroughly. Turn off all lights except the safelight. The safelight should be placed at least 4 feet from your work.

F. Remove one sheet of photographic paper and close the package so light can not get in. Place the negative so the dull side faces the shiny side of the paper. The negatives should be near the light source. Cover with the glass.

G. If a print frame is being used with a 7-watt bulb, hang the bare bulb 2 feet above the frame and turn it on for about 10 seconds. Getting the correct exposure time may require experimentation.

H. If an enlarger is used, place the empty negative carrier in the enlarger and set the lens at F/11. The enlarger should be adjusted so the light covers an area a little larger than the paper. Expose for about 8 seconds. You may have to experiment to get the correct exposure time.

I. Remove the paper from the printing device with your left hand (do not get your right hand wet with developer) and slide the paper into the developer. Make sure shiny side is up. Rock the tray gently for 1 1/2 minutes by tipping up on one end and then the other end.

J. Remove the paper from the developer with your left hand. Let the paper drain for one or two seconds and slide the paper into the stop bath (center tray). Using the same method of agitation as in step I, agitate the tray for 5 to 10 seconds.

K. Remove the paper from the stop bath with your right hand and place the paper into the fixer. Agitate the prints frequently for 2 minutes and keep the prints separate from other prints in the fixing tray. After the prints have been in the fixer for 25-30 seconds, the lights can be turned on.

L. If most of the pictures on the proof sheet seem to be too light, make another proof sheet and double the exposure time used on the first. Cut the exposure time in half if most of the pictures seem too dark. You should keep notes on the exposure time and the results.

M. Wash the print for 4 minutes at 65 to 70° F in the fourth tray. Agitate the print frequently while it is washing while using running wter.

N. Sponge or squeegee the surface water from both sides of the print and place it onto a flat surface to dry at room temperature.

UNIT TEST

Match the terms from photo printing with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. A __________ is a photographic print made by placing the negative and printing paper in direct contact for exposure.

_____ 2. A __________ is a working light source for making photographic prints.

_____ 3. A __________ is a positive image on photographic paper.

_____ 4. __________ is the degree of lightness or darkness in any given area of a print.

_____ 5. The __________ of a print is the shades of white in the finished print and is controlled by the color of the paper.

_____ 6. A __________ is a device used for contact printing that holds the negative against the photographic paper.

_____ 7. To __________ film development means developing longer than normal and increases the speed of the film.

_____ 8. __________ paper can have its contrast changed by using filters calibrated in contrast grades.

_____ 9. __________ is printing paper with a plastic coating under the emulsion.

_____ 10. A __________ is a strip of photographic paper on which trial exposures of different lengths are made to determine the correct exposures.

A. Safelight

B. Printing frame

C. RC Paper

D. Tone

E. Test strip

F. Variable Contrast

G. Push

H. Contact Print

I. Tint

J. Print

ANSWERS TO TEST

1. H
2. A
3. J
4. D
5. I
6. B
7. G
8. F
9. C
10. E

EQUIPMENT & SUPPLIES

I. Equipment

- A. 6--Printing frames with 7-watt light bulbs
- B. 24--trays 8 X 10 inches
- C. 6--Stirring rods
- D. 6--Darkroom Graduates
- E. 8--Large jars
- F. 6--Darkroom timers
- G. 6--Rubber squeegees
- H. 1--Safelight (if you do not have one in a darkroom)

II. Supplies

- A. 100-Sheets (4 packages) of Kodak Polycontrast Rapid RC Paper, 8 X 10 inches
- B. 2--Gallons of Kodak Dektol Developer
- C. Use the Kodak Indicator Stop Bath and Kodak Fixer left over from developing the negatives.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

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Instructional Section:

PHOTOGRAPHY

Title of Unit:

PHOTOGRAPHIC FILTERS

DESCRIPTION OF UNIT

This unit will cover the basic lens filters used in black and white photography. It will give guidelines for selecting the proper filter to use for a given situation, the proper lens opening, and the size of filters. The materials in this unit are designed for 3 hours of instruction.

UNIT OBJECTIVE

Upon completion of this unit the student will be able to explain the results of using a particular filter in a certain situation. The student will be able to explain the filter factor and how to properly use it.

PERFORMANCE OBJECTIVE

After completion of this unit the student will be able to:

1. Match the type of filter to be used with the conditions described.
2. Explain the meaning of filter factor and how to set the camera to compensate for it.
3. Identify the various types of filters.

OUTLINE OF CONTENT

I. A light filter removes or tones down certain light rays.

II. The color of the filter will make that color in the photograph lighter.

III. Filter Factor is the amount that the filter dims the brightness reading of the film making it necessary to use a larger lens opening.

IV. Cameras with built in light meters will tell you the proper lens opening to use.

V. The filter screws into the end of the lens.

VI. Types

  A. Polarizing - Remove glare caused by sun or by the sun being reflected off objects.

  B. Red - Lightens up red colors.

  C. Green - Lightens up green colors.

  D. Yellow - Lightens up yellow colors.

  E. Blue - Lightens up blue colors.

VII. Filter Factor

  A. The amount the filter dims the view or the amount of light that is withheld from the film.

  B. This means that the shutter opening will have to be made larger.

  C. A filter factor of X 1 means 1/2 of a stop, a factor of X 2 means 1 stop, and tells how much to open up the lens.

TEACHER ACTIVITIES

I. Provide students with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through the outline of content.

IV. Show students pictures showing results of using particular filters on the same picture (see Photo One).

V. Discuss the student activity sheet.

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Study pictures showing the results obtained by using different filters.

IV. Complete Activity Sheet.

V. Take test.

REFERENCES/RESOURCES

I. References

  A. Gerace, Philip G.; Mangione, Stephen S., Communication: Photography, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

  B. Muse, Ken, Photo One, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1973.

II. Resources

  A. Information Sheets.

  B. Pictures in Photo One.

Information Sheet #1

Terms and Definitions:

Filter - A glass or plastic disk which screws into the front of the lens and helps remove some of a particular color as its rays enter the lens.

Filter Factor - The amount of light that a filter keeps from entering the lens. The filter factor written on the filter tells how much to open the lens to compensate for the filter. Example: X 2 on the filter means to open the opening one stop F28 - F4 - F5.6 - F8.

Polarizing Filter - A filter that removes the harshness and glare caused by bright sunlight.

Student Activity #1

USING FILTERS

Objective:

You will take the materials given and complete the following: use each of the filters to take an exposure of the same object and evaluate the results.

Materials:

1. 1--35-mm SLR Camera
2. 1--Tripod
3. 1--Light meter
4. 1--Set of filters (include blue, green, yellow, red, and polarizing)
5. 1--Shutter release cable
6. 1--Roll of Plus-X Pan Film

Procedure:

1. Load camera with the film making sure the proper speed is properly set.
2. Three students will use the same camera and film.
3. Expose the film without the use of a filter.
4. Use the same setting and objects as used for the original exposure except use each of the filters.
5. Set the opening of the lens according to the recommendations on the filter.

UNIT TEST

Match the terms from the types of filters with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. A glass or plastic disk which screws into the front of the lens and helps remove some of a particular color as its rays enter the lens.

_____ 2. A __________ filter that removes the harshness and glare caused by bright sunlight.

_____ 3. The amount of light that a filter keeps from entering the lens.

A. Filter Factor

B. Filter

C. Polarizing

ANSWERS TO TEST

1. B

2. C

3. A

EQUIPMENT/SUPPLIES

I. Equipment

   A. 8--35-mm SLR Cameras

   B. 8--Tripods

   C. 8--Lightmeters

   D. 8--Shutter release cables

   E. 8--Sets of filters for the above cameras

II. Supplies

   A. 8--Rolls of Plus-X Pan Film

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

PHOTOGRAPHY

Title of Unit:

PHOTOGRAPHIC PAPERS

DESCRIPTION OF UNIT

This unit will cover the various types of photographic papers used for making enlargements and their characteristics. The materials in this unit are designed for 2 hours of instruction.

UNIT OBJECTIVE

Upon completion of this unit the student will know the basic types of photographic paper and the characteristics of each. The student will be able to choose the best paper to obtain the desired results.

PERFORMANCE OBJECTIVE

After completion of this unit the student will be able to:

1. Select the best photographic paper to obtain the desired results.
2. List the various types of photographic paper available and discuss their characteristics.

OUTLINE OF CONTENT

I. Paper bases

  A. Single Weight--S.W.

  B. Light Weight--L.W.

  C. Double Weight--D.W.

    1. Used in large prints

    2. Better handling characteristics

  D. Medium Weight--M.W.

    1. Preferable for enlargements

    2. Good handling characteristics

II. Surfaces

  A. Glossy

    1. Best for brilliant prints.

    2. Best reproduction of fine detail.

    3. Good for album prints and pictures to be published in books and magazines.

    4. Dry glossy prints on ferrotype plates or on a ferrotype dryer to obtain the highest gloss.

    5. Do not ferrotype any Kodak RC Papers.

  B. High Lustre

    1. Sheen slightly less than glossy paper.

    2. Good for prints requiring a great deal of brilliance without ferrotyping.

  C. Lustre

    1. Has a midway sheen between Glossy and Matte.

    2. Provides an intermediate brilliance to portraits and subjects requiring moderate sparkle.

D. Matte

1. Subdues brilliance.
2. Used for low-key (dark-tone) or high-key (light-tone) pictures and atmospheric landscapes.
3. Used widely by portrait photographers.

III. Texture

A. Smooth

1. Has no noticeable surface pattern to interfere with reproduction of fine detail.
2. Best surface for small prints.

B. Fine-Grained

1. A slightly pebbled surface.
2. Does not lose definition.
3. Good for scenic views, children's portraits and exhibition prints.

C. Silk

1. Has a clothlike texture with a high-lustre surface.
2. Good for snow and water scenes, wedding pictures, still lifes and some portraits.

D. Tweed

1. A rough and obvious texture.
2. Texture hides fine details.
3. Emphasis masses in landscapes and portraits.
4. Suitable for large artistic prints.

E. Tapestry

1. The texture resembles an artist's canvas.
2. Detail is subdued to a maximum.
3. Best for large prints.

IV. Stock Tint

A. White

1. Best for cold-toned subjects (snow scenes; sea-scapes).

2. Good for high-key pictures where blue tones are desired.

3. Good for general use.

B. Warm White

1. Very good for general subjects when warmth is desired.

2. The tint is midway between white and cream white.

C. Cream White

1. A good choice for general subjects.

2. Well-suited to subjects photographed by daylight or artificial light.

V. Contrast Grade

A. No. 0--for negatives with very high contrast.

B. No. 1--for negatives with high contrast.

C. No. 2--for negatives with normal contrast.

D. No. 3--for negatives with less than normal contrast.

E. No. 4--for negatives with low contrast.

F. No. 5--for negatives with very low contrast.

VI. Image Tone

A. Warm tone tends toward brown.

B. Cold tone tends toward blue.

C. Designations for Kodak papers are:

1. Blue-black

2. Neutral-black

3. Warm--black

4. Brown-black

VII. Resin Coating

A. Characteristic of Kodak RC Papers

B. Helps prevent processing chemicals from printing the paper base which reduces fixing, washing, and drying times.

D. It eliminates the need for ferro-typing.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through the outline of content.

IV. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Take test.

REFERENCES/RESOURCES

I. References

A. Basic Developing, Printing, Enlarging in Black and White; Eastman Kodak Company #AJ-2, Consumer Markets Division, Rochester, New York; 1977.

B. CBIE Project, Industrial Education Visual Communication Revised, Kansas State Department of Education, Wichita, Kansas.

II. Resources

A. Information Sheets

B. Activity Sheets

Information Sheet #1

I. Paper bases

   A. Single Weight--S.W.

   B. Light Weight--L.W.

   C. Double Weight--D.W.

      1. Used in large prints

      2. Better handling characteristics

   D. Medium Weight--M.W.

      1. Preferable for enlargements

      2. Good handling characteristics

II. Surfaces

   A. Glossy

      1. Best for brilliant prints.

      2. Best reproduction of fine detail.

      3. Good for album prints and pictures to be published in books and magazines.

      4. Dry glossy prints on ferrotype plates or on a ferrotype dryer to obtain the highest gloss.

      5. Do not ferrotype any Kodak RC Papers.

   B. High Lustre

      1. Sheen slightly less than glossy paper.

      2. Good for prints requiring a great deal of brilliance without ferrotyping.

   C. Lustre

      1. Has a midway sheen between Glossy and Matte.

      2. Provides an intermediate brilliance to portraits and subjects requiring moderate sparkle.

D. Matte

1. Subdues brilliance.

2. Used for low-key (dark-tone) or high-key (light-tone) pictures and atmospheric landscapes.

3. Used widely by portrait photographers.

III. Texture

A. Smooth

1. Has no noticeable surface pattern to interfere with reproduction of fine detail.

2. Best surface for small prints.

B. Fine-Grained

1. A slightly pebbled surface.

2. Does not lose definition.

3. Good for scenic views, children's portraits and exhibition prints.

C. Silk

1. Has a clothlike texture with a high-lustre surface.

2. Good for snow and water scenes, wedding pictures, still lifes and some portraits.

D. Tweed

1. A rough and obvious texture.

2. Texture hides fine details.

3. Emphasis masses in landscapes and portraits.

4. Suitable for large artistic prints.

E. Tapestry

1. The texture resembles an artist's canvas.

2. Detail is subdued to a maximum.

3. Best for large prints.

IV. Stock Tint

   A. White

      1. Best for cold-toned subjects (snow scenes; sea-scapes).

      2. Good for high-key pictures where blue tones are desired.

      3. Good for general use.

   B. Warm White

      1. Very good for general subjects when warmth is desired.

      2. The tint is midway between white and cream white.

   C. Cream White

      1. A good choice for general subjects.

      2. Well-suited to subjects photographed by daylight or artificial light.

V. Contrast Grade

   A. No. 0—for negatives with very high contrast.

   B. No. 1—for negatives with high contrast.

   C. No. 2—for negatives with normal contrast.

   D. No. 3—for negatives with less than normal contrast.

   E. No. 4--for negatives with low contrast.

   F. No. 5—for negatives with very low contrast.

VI. Image Tone

   A. Warm tone tends toward brown.

   B. Cold tone tends toward blue.

   C. Designations for Kodak papers are:

      1. Blue-black

      2. Neutral-black

      3. Warm—black

      4. Brown-black

VII. Resin Coating

A. Characteristic of Kodak RC Papers

B. Helps prevent processing chemicals from printing the paper base which reduces fixing, washing, and drying times.

D. It eliminates the need for ferro-typing.

Information Sheet #2

Terms and Definitions:

A. Photographic characteristics - These describe the contrast grade and speed of photographic paper.

B. Physical characteristics - These describe the image tone, surface sheen and texture, stock tint, coating, and weight.

C. Contrast Grade - A number telling the amount of contrast that can be expected with that photographic paper. The contrast grade numbers range from 0 through 5 with 0 for high contrast negatives and 5 for very low contrast negatives. Example: To produce normal contrast in prints, use low-contrast paper with high-contrast negatives and high-contrast paper with low-contrast negatives.

D. Contrast - The difference between the light and dark areas of a negative, print or slide.

E. Speed - The sensitivity of paper to light and is less than that of film.

F. Image tone - The color of the character or image in the finished print.

G. Surface sheen - The characteristic of paper which determines the maximum blackness the paper can produce.

H. Texture - The roughness of the paper which determines how the paper reproduces the fine details from a negative. The smoother the texture the finer the detail that can be reproduced.

I. Stock tint - The color of the photographic paper.

J. Weight - The thickness of the photographic paper.

UNIT TEST

Match the terms with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. __________ is the difference between the light and dark areas of a negative, print, or slide.

_____ 2. __________ is the color of the character or image in the finished print.

_____ 3. The thickness of photographic paper is its __________.

_____ 4. The __________ is the color of the photographic paper.

_____ 5. __________ is the roughness of the paper which determines how the paper reproduces the five details from a negative.

_____ 6. The __________ of the paper is its sensitivity to light.

_____ 7. __________ is the characteristic of photographic paper which determines the maximum blackness a paper can produce.

_____ 8. The __________ is the number telling the amount of contrast that can be expected with that paper.

A. Image Tone

B. Texture

C. Weight

D. Contrast

E. Stock Tint

F. Surface Sheen

G. Speed

H. Contrast Grade

Match the photographic paper characteristic to its description by placing the letter in the blank by the description.

_____ 1. __________ is the paper base that is preferred for enlargements and has good handling characteristics.

_____ 2. The __________ texture is clothlike and good for snow and water scenes.

_____ 3. The __________ surface paper is best for brilliant prints and produces fine detail best.

_____ 4. The __________ contrast grade paper is best for very high contrast negatives.

A. Silk

B. Tweed

C. Glossy

D. Matte

E. No. 0

F. No. 5

G. Double

H. Medium

TEST (continued)

_____ 5. __________ contrast paper is best for very low contrast negatives.

_____ 6. A __________ texture paper has a rough texture and usually hides fine details.

_____ 7. A __________ paper base is the photographic paper used for large prints.

_____ 8. A __________ surface paper subdues brilliance and is used for low-key or high-key pictures.

ANSWERS TO TEST

1. D	5. B
2. A	6. G
3. C	7. F
4. E	8. H

Paper Characteristics

1. H	5. F
2. A	6. B
3. C	7. G
4. E	8. D

COMMUNICATIONS

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

PHOTOGRAPHY

Title of Unit:

MAKING ENLARGEMENTS

DESCRIPTION OF UNIT

This unit will cover the basic techniques used in enlarging prints. It will give an overview of the following areas: the darkroom equipment used for enlarging, the various chemicals used in making an enlargement and how to correct problems in enlargements. The materials in this unit are designed for 8 hours of instruction.

UNIT OBJECTIVE

Upon completion of this unit the student will be able to explain each step in making enlargements, name and give the use of the darkroom equipment used in making enlargements, use the enlarger correctly, and give the names and purposes of the chemicals used to enlarge negatives. The student will also demonstrate the ability to make quality enlargements by using proper chemicals and equipment.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Match terms associated with enlarging to the correct description or definition.
2. List and describe the basic chemicals used in enlarging.
3. Identify the tools and equipment used in enlarging and tell each one's use.
4. Briefly list in order the steps used in enlarging.

5. Demonstrate the ability to:

   A. Set up the equipment and chemicals needed to make an enlargement.

   B. Properly mix all chemicals needed to make enlargements.

   C. Properly use all equipment used to make enlargements.

   D. Make quality enlargements.

OUTLINE OF CONTENT

I. An enlargement is a print that is larger than the negative.

II. Procedure for enlarging

   A. Set up 3 trays: developer, stop bath, and fixer.

   (Note: These are the same as the ones used for making a proof sheet.)

   B. Mix chemicals according to directions on packages with water that is at a temperature of 68-75° F.

   C. Dust negative carefully with a camel's hair brush while holding it by its edges. Be sure to dust both sides of the negative.

   D. After selecting the proper negative carrier, dust the glass and place the negative in the carrier with the emulsion side (the dull one) down.

   E. To aid in focusing the enlarger, place a piece of white typing paper under the guides of the enlarging easel.

   F. Turn on the safelight and turn off other lights.

   G. Set the lens of the enlarger to its largest opening (smallest number).

   H. After turning the enlarger on, adjust the enlarger height so your picture has the desired negative image within the easel guides.

   I. Bring the picture into focus by adjusting the enlarger lens.

   J. Now change the lens setting to F-11 and turn the enlarger off.

   K. Place the sheet of Kodak Polycontrast Rapid RC Paper on the easel with emulsion side up (shiny side).

   L. With a sheet of cardboard cover all the sheet except a sixth. At 5 second intervals expose an additional sixth of the paper. After 30 seconds, turn off the enlarger.

   M. Process the test sheet.

      1. 1 1/2 minutes in the developer.

      2. 5 seconds in the stop bath.

      3. Slide into the fixer for 25-30 seconds.

N. Turn on the lights.

O. Inspect the test print and choose the exposure time which gave the best result.

P. Turn out the lights and place a piece of photographic paper into the easel.

Q. Expose the paper and process it as on the test print but with a 2 minute fixing time. After 25-30 seconds turn on the lights.

R. Wash the enlargement for 4 minutes at 65 to 70° F.

S. Use running water and agitate the print frequently while it is washing.

T. Squeegee surface water from both sides of the print.

U. Lay the print on a flat surface to dry at room temperature.

III. Techniques for printing and enlarging

A. Cropping - Using part of the image that is in the negative to make a more pleasing print.

1. Take two L-shaped pieces of paper and place them on the contact print.
2. Move the L-shaped cardboard around until the best looking picture is seen inside the L's.
3. Mark the area to be cropped with a grease pencil.
4. Adjust the enlarger to take in the area marked with the grease pencil and make the enlargement.

B. Vignetting - A technique used in enlargements to eliminate distracting or unwanted backgrounds.

1. Most popular when printing high key portraits (portraits made up of mostly light gray tones).
2. Vignetting is done from a negative through a hole in opaque cardboard.
    a. Hole should be the size that gives the desired effect when held halfway between the enlarger lens and the paper.
    b. The edges of the cardboard should be feathered or rough-cut so the image fades gradually into the white paper.
3. Keep the vignetter in continuous motion during print exposure.

C. Dodging - Holding back light from the projected image during exposure time so that the photographic paper receives less than normal exposure in areas that were too dark in the straight print.

   1. Cut the needed shape from a piece of dark cardboard.

   2. Tape the cardboard to a piece of wire.

   3. While exposing the print, hold the wire attached to the cardboard so the cardboard is over the area which is too dark on the projected image.

   4. Move the cardboard and wire while making the exposure so the wire and cardboard image will not show up on the print.

D. Diffusing - Softening detail in a print with a diffusing disk or other material that scatters light. A diffusing disk is a flat glass with a pattern of lines or concentric rings that breaks up and scatters light from an enlarger lens.

E. Burning-in - Giving additional exposure to part of the image projected on an enlarger easel to make that area of the print darker.

   1. After the basic exposure extend the exposure time to allow light to hit the light areas for a longer time.

   2. Light is withheld from the area which is dark enough by holding dark cardboard over that area.

   3. The cardboard should be held halfway between the enlarger lens and the paper.

   4. The paper should be kept in constant motion.

   5. This procedure is also called printing-in.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through the outline of content.

IV. Demonstrate each step involved in making enlargements stressing each step and the proper procedures for each step.

V. Discuss the student activity sheet.

VI. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Pay attention to and learn the steps and procedures gone over in the demonstrations given in this unit.

IV. Complete activity sheets.

V. Take test.

REFERENCES/RESOURCES

I. References

A. Basic Developing, Printing, Enlarging in Black and White, Eastman Kodak Company #AJ-2, Consumer Markets Division, Rochester, New York: 1977.

B. CBIE Project, Industrial Education Visual Communication Revised, Kansas State Department of Education, Wichita, Kansas.

C. Gerace, Philip G.; Mangione, Stephen S., Communication: Photography, MET Series, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

D. Muse, Ken; Photo One, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1973.

II. Resources

A. Information Sheets

B. Activity Sheets

C. Demonstrations

Information Sheet #1

I. An enlargement is a print that is larger than the negative.

II. Procedure for enlarging

- A. Set up 3 trays: developer, stop bath, and fixer.

  (Note: These are the same as the ones used for making a proof sheet.)

- B. Mix chemicals according to directions on packages with water that is at a temperature of 68-75° F.
- C. Dust negative carefully with a camel's hair brush while holding it by its edges. Be sure to dust both sides of the negative.
- D. After selecting the proper negative carrier, dust the glass and place the negative in the carrier with the emulsion side (the dull one) down.
- E. To aid in focusing the enlarger, place a piece of white typing paper under the guides of the enlarging easel.
- F. Turn on the safelight and turn off other lights.
- G. Set the lens of the enlarger to its largest opening (smallest number).
- H. After turning the enlarger on, adjust the enlarger height so your picture has the desired negative image within the easel guides.
- I. Bring the picture into focus by adjusting the enlarger lens.
- J. Now change the lens setting to F-11 and turn the enlarger off.
- K. Place the sheet of Kodak Polycontrast Rapid RC Paper on the easel with emulsion side up (shiny side).
- L. With a sheet of cardboard cover all the sheet except a sixth. At 5 second intervals expose an additional sixth of the paper. After 30 seconds, turn off the enlarger.
- M. Process the test sheet.
  1. 1 1/2 minutes in the developer.
  2. 5 seconds in the stop bath.
  3. Slide into the fixer for 25-30 seconds.

N. Turn on the lights.

O. Inspect the test print and choose the exposure time which gave the best result.

P. Turn out the lights and place a piece of photographic paper into the easel.

Q. Expose the paper and process it as on the test print but with a 2 minute fixing time. After 25-30 seconds turn on the lights.

R. Wash the enlargement for 4 minutes at 65 to 70° F.

S. Use running water and agitate the print frequently while it is washing.

T. Squeegee surface water from both sides of the print.

U. Lay the print on a flat surface to dry at room temperature.

III. Techniques for printing and enlarging

A. Cropping - Using part of the image that is in the negative to make a more pleasing print.

1. Take two L-shaped pieces of paper and place them on the contact print.

2. Move the L-shaped cardboard around until the best looking picture is seen inside the L's.

3. Mark the area to be cropped with a grease pencil.

4. Adjust the enlarger to take in the area marked with the grease pencil and make the enlargement.

B. Vignetting - A technique used in enlargements to eliminate distracting or unwanted backgrounds.

1. Most popular when printing high key portraits (portraits made up of mostly light gray tones).

2. Vignetting is done from a negative through a hole in opaque cardboard.

a. Hole should be the size that gives the desired effect when held halfway between the enlarger lens and the paper.

b. The edges of the cardboard should be feathered or rough-cut so the image fades gradually into the white paper.

3. Keep the vignetter in continuous motion during print exposure.

C. Dodging - Holding back light from the projected image during exposure time so that the photographic paper receives less than normal exposure in areas that were too dark in the straight print.

1. Cut the needed shape from a piece of dark cardboard.

2. Tape the cardboard to a piece of wire.

3. While exposing the print, hold the wire attached to the cardboard so the cardboard is over the area which is too dark on the projected image.

4. Move the cardboard and wire while making the exposure so the wire and cardboard image will not show up on the print.

D. Diffusing - Softening detail in a print with a diffusing disk or other material that scatters light. A diffusing disk is a flat glass with a pattern of lines or concentric rings that breaks up and scatters light from an enlarger lens.

E. Burning-in - Giving additional exposure to part of the image projected on an enlarger easel to make that area of the print darker.

1. After the basic exposure extend the exposure time to allow light to hit the light areas for a longer time.

2. Light is withheld from the area which is dark enough by holding dark cardboard over that area.

3. The cardboard should be held halfway between the enlarger lens and the paper.

4. The paper should be kept in constant motion.

5. This procedure is also called printing-in.

Information Sheet #2

Terms and Definitions

Blowup - An enlargement; a print that is made bigger than the negative or slide.

Condenser enlarger - An enlarger with a sharp, undiffused light that produces high contrast and high definition in a print.

Contrast - The density range of a negative, print, or slide; the brightness range of a subject or the scene lighting.

Contrast grade - Numbers--usually 0-5--designating the grades available in different photographic papers. Grade 0 has the lowest contrast and grade 5 the highest. The grade 0 paper is designed for use with contrasty negatives to give prints that most closely resemble the original scene. Grade 5 paper is designed for use with low-contrast negatives.

Definition - The impression of clarity of detail perceived by an observer viewing a photograph.

Density - The blackness of an area in a negative or print which determines the amount of light that will pass through it or reflect from it.

Diffusion-condenser enlarger - An enlarger that combines diffuse light with a condenser system, producing more contrast and sharper detail than a diffusion enlarger, but less contrast and blemish emphasis than a condenser enlarger.

Diffusion enlarger - An enlarger that scatters light before it strikes the negative, distributing light evenly on the negative. Detail is not as sharp as with a condenser enlarger.

Enlargement - A print that is larger than the negative or slide.

Enlarger - A device consisting of a light source, a negative holder, and a lense, and a means of adjusting these to project an enlarged image from a negative onto a sheet of photographic paper.

Ferratype Plate - A chromium-plated or black-enameled sheet of steel, or mirror-plated glass, used to dry prints to a high-gloss finish; the procedure is sometimes defined as "glazing".

Tone - The degree of lightness or darkness in any given area of a print.

Toning - Intensifying or changing the tone of a photographic print after processing. Solution called "toners" are used to produce various shades of brown and blue.

PH 9.13

Student Activity #1

MAKING ENLARGEMENTS

Objective:

You will take the materials given and the negatives and the proof sheet from the previous lessons to complete: enlargements of the pictures you have taken.

Materials:

1. An enlarger
2. Safelight (used in making contact prints)
3. Four trays (used in making contact prints)
4. A darkroom graduate
5. A darkroom thermometer
6. A stirring rod
7. A darkroom timer
8. Rubber squeegee
9. Easel for holding the paper
10. Kodak Polycontrast Rapid RC Paper
11. The same chemicals used to make the proof sheet
12. A camel's hair brush

Procedure

A. Set up 3 trays: developer, stop bath, and fixer.

(Note: These are the same as the ones used for making a proof sheet.)

B. Mix chemicals according to directions on packages with water that is at a temperature of 68-75° F.

C. Dust negative carefully with a camel's hair brush while holding it by its edges. Be sure to dust both sides of the negative.

D. After selecting the proper negative carrier, dust the glass and place the negative in the carrier with the emulsion side (the dull one) down.

E. To aid in focusing the enlarger, place a piece of white typing paper under the guides of the enlarging easel.

F. Turn on the safelight and turn off other lights.

G. Set the lens of the enlarger to its largest opening (smallest number).

H. After turning the enlarger on, adjust the enlarger height so your picture has the desired negative image within the easel guides.

I. Bring the picture into focus by adjusting the enlarger lens.

J. Now change the lens setting to F-11 and turn the enlarger off.

K. Place the sheet of Kodak Polycontrast Rapid RC Paper on the easel with emulsion side up (shiny side).

L. With a sheet of cardboard cover all the sheet except a sixth. At 5 second intervals expose an additional sixth of the paper. After 30 seconds, turn off the enlarger.

M. Process the test sheet.

1. 1 1/2 minutes in the developer.
2. 5 seconds in the stop bath.
3. Slide into the fixer for 25-30 seconds.

N. Turn on the lights.

O. Inspect the test print and choose the exposure time which gave the best result.

P. Turn out the lights and place a piece of photographic paper into the easel.

Q. Expose the paper and process it as on the test print but with a 2 minute fixing time. After 25-30 seconds turn on the lights.

R. Wash the enlargement for 4 minutes at 65 to 70° F.

S. Use running water and agitate the print frequently while it is washing.

T. Squeegee surface water from both sides of the print.

U. Lay the print on a flat surface to dry at room temperature.

UNIT TEST

Match the following terms with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. A print that is larger than the negative or slide.

_____ 2. The degree of lightness or darkness in any area of a print.

_____ 3. The blackness of an area in a negative or print which determines the amount of light that will pass through it or reflect from it.

_____ 4. Softening detail in a print with a diffusing disk or other material that scatters light.

_____ 5. Holding back light from the projected image during exposure time so that the photographic paper receives less than normal exposure in areas that were too dark in the straight print.

_____ 6. Giving additional exposure to part of the image projected on an enlarger easel to make that area of the print darker.

_____ 7. Using part of the image that is in the negative to make a more pleasing print.

_____ 8. A means of eliminating unwanted backgrounds by projecting light through a hole in opaque cardboard.

_____ 9. A device consisting of a light source, a negative holder, and a lense, and a means of adjusting these to project an enlarged image from a negative onto a sheet of photographic paper.

_____10. An enlarger with a sharp-undiffused light that produces high contrast and high definition in a print.

A. Tone

B. Cropping

C. Density

D. Condenser enlarger

E. Vignetting

F. Enlargement

G. Burning in

H. Diffusion

I. Enlarger

J. Dodging

ANSWERS TO TEST

1. F
2. A
3. C
4. H
5. J
6. G
7. B
8. E
9. I
10. D

EQUIPMENT/SUPPLIES

I. Equipment

  A. 6--Easels for holding photographic paper

  B. 24--Trays 8 X 10 inches

  C. 6--Stirring rods

  D. 6--Darkroom Graduates

  E. 8--Large jars

  F. 6--Darkroom timers

  G. 6--Rubber squeegees

  H. 6--Enlargers

  I. 6--Camel's hair brushes

  J. 6--Darkroom thermometers

II. Supplies

  A. 100-sheets (4 packages) of Kodak Polycontrast Rapid RC Paper, 8 X 10 inches

  B. 2--Gallons of Kodak Dektol Developer

  C. Use the Kodak Indicator Stop Bath and Kodak Fixer left over from other darkroom work.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

PHOTOGRAPHY

Title of Unit:

PHOTOGRAPHIC ACTIVITIES

DESCRIPTION OF UNIT

This unit will cover the preparation of a photographic presentation to be turned in at the completion of the photographic instructional section. The materials in this unit are designed for 1 hour of instruction.

UNIT OBJECTIVE

After completion of this unit each student will be able to turn in a well arranged and attractive photographic presentation.

PERFORMANCE OBJECTIVE

Upon completion of this unit the student will be able to:

1. Complete a well arranged and attractive photographic presentation.

OUTLINE OF CONTENT

I. The Year That Was

  A. A scrap book of school events:
    1. Plays
    2. Pep rallies
    3. Ball games
    4. Academic activities

  B. A poster board mount of school events

II. Slide Presentation Of:
  A. Community event
    1. Play
    2. Picnic (club)
    3. Club meeting

  B. Types of equipment
    1. Earth movers
    2. Fire fighting

  C. How to complete a task
    1. Change a tire
    2. Tune up a lawn mower engine

  D. News Event
    1. Famous person arrives in town
    2. Dedication of a new building

III. Film Presentation
  A. Use either 8 mm or 16 mm camera

  B. Subjects
    1. Ball games
    2. Race
    3. Utility or building construction

IV. Student portfolio
  A. Contains picture taken during the class

  B. Explanation of the quality

V. Student Photo Contest
  A. Action
  B. Black and White
  C. Color
  D. Still Life
  E. Portrait

VI. Each area of this activity should be open to students not in the Industrial Arts program to help to develop good public relations.

TEACHER ACTIVITIES

I. Provide students with student module.

II. Discuss unit and specific objectives.

III. Discuss information sheets and go through outline of material.

IV. Discuss student activity sheets.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Complete activity sheet.

REFERENCE/RESOURCES

I. References

A. Gerace, Philip G.; and Mangoine, Stephen S., Communication: Photography, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1976.

B. Photo Reports Make It Happen, Rochester, New York: Kodak, Consumer Markets Division, No. AT-5.

C. Student Pictures For School Publications, Rochester, New York: Kodak, Consumer Markets Division, No. AT-13.

II. Resources

A. Objective Sheet

B. Information Sheet

C. Student Activity Sheet

Information Sheet #1

PHOTOGRAPHIC ACTIVITIES

I. The Year That Was
   A. Students will photograph school activities during the project preparation time.
   B. Regular size photographs should be used. (no enlargements)
   C. Only half the pictures in the album may be color
   D. The album should be of the standard size sold in stationary stores.
   E. No more than 5 photographs should be placed on each page.
   F. Do not place photographs on the back of pages.
   G. Only ten (10) pages should be filled.

II. Slide Presentation
   A. The presentation should tell how to perform some tasks or tell a story.
   B. Do not have any slides not related to the subject area of the presentation.
   C. Use a maximum of twenty (20) slides in the presentation.
   D. Slides must be placed in a projector carousel.
   E. All slides should be placed in the proper direction before starting the presentation.

III. Film Presentation
   A. Use either 8 mm or 16 mm film for the presentation.
   B. The film should deal only with the subject matter of the film.
   C. The film should be edited prior to the presentation.
   D. The presentation should be limited to about 6 minutes.

IV. Student Portfolio
   A. Include a sample of all pictures which have been taken from the first to the last.
   B. Place only four (4) pictures on each page.
   C. Use 8 1/2" by 11" plain white typing paper to mount the pictures.
   D. Do not tape picture to the paper-use a small amount of rubber cement.
   E. Do not include any enlargements.
   F. Include 20 pictures in the portfolio.
   G. The first page of the portfolio should contain a written evaluation by the student of what he has learned.

V. Student Photo Contest
   A. A student may have only two photographs from each of the following areas:
      1. Action-Showing movement of a person, animal, or object.
      2. Black and White.
      3. Color.
      4. Still Life-From nature showing a scene in which there is little or no movement.

5. Portrait-Of A Person.

B. Do not use enlargements for this activity.
C. Photos should be mounted on matt board using a dry mount.
D. Pictures from the same area should be placed side by side.
E. Mount only one picture per mount.

Student Activity #1

PHOTOGRAPHIC ACTIVITIES

Objective

You will take materials needed and correctly complete one of the following activities.

Materials

Students should supply the materials needed for the activity that is chosen.

I. The Year That Was-Standard Photo Albums

II. Slide Presentation-Slide carousel

III. Movie - Film

IV. Student Portfolio--

1. 10 pieces of 8 1/2 x 11 white typing paper
2. 1 bottle of rubber cement

V. Student Photo Contest

1. Matt board
2. Dry mounting sheets
3. Tacking iron
4. X-acto knife
5. Mounting press or flat iron.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

PHOTOGRAPHY

Title of Unit:

PRE-TEST/POST-TEST

MASTER EQUIPMENT AND SUPPLY LIST

PRE-TEST

Match the terms on the right to the correct description.

_____ 1. __________ was the American who developed a hand-held camera that had film in it.

_____ 2. __________was able to produce a permanent image on a negative.

_____ 3. The holding device for the electronic flash.

_____ 4. The device which controls the time that the film will be exposed to light.

_____ 5. The size of the lens opening.

_____ 6. The glass opening which reduces the image to film size and produces a clear and sharp picture on the film.

_____ 7. Shows the image that is seen by the lens of the camera.

_____ 8. That part of the camera that holds the film and has the other parts of the camera attached.

_____ 9. The lever which controls the movement of film from exposed to unexposed.

_____10. A battery powered lighting device used to provide more light in a poorly lit photographic situation.

_____11. The plastic base of film which carries the emulsion.

_____12. Silver grains combined with a halogen element.

_____13. A length of protective film at the beginning of a roll of film.

_____14. The number given the speed of the film.

_____15. The sand-like or granular appearance of a negative, print, or slide resulting from the dumping of silver grains during development of the film.

A. Hot Shoe
B. F-Stop
C. Lens
D. Body
E. Eastman
F. Shutter
G. Dagure
H. Viewfinder
I. Advance Lever
J. Acetate
K. Silver Halide
L. ASA
M. Electronic Flash
N. Film leader
O. Graininess

PRE-TEST

Match the parts of the eye to the parts of the camera which serves the same function.

Eyeball (Whole)

Iris

Eyelid

Shutter

Camera box

Camera diaphram

Label the parts of the camera on the following page next to the appropriate letter.

A.

B.

C.

D.

E.

F.

G.

H.

I.

Match the developing terms on the right to the correct description.

_____ 1. The __________ is the solution used to turn the latent image into a visible image on exposed film or photographic paper.

_____ 2. __________is a chemical that neutralizes hypo in film or paper, reducing washing time and helping to provide a more stable image.

_____ 3. __________is a fixing bath made from sodium thiosulfate, other chemicals, and water.

_____ 4. The __________ is a solution that removes any light sensitive salt not acted upon by light or developer leaving a black-and-white negative print unalterable by further action of light.

_____ 5. A __________ is developed film that contains a reversed-tone image of the original scene.

A. Clearing Agent

B. Fixing Bath

C. Developer

D. Negative

E. Hypo

PH 11.4

PRINT TERMS

Match the terms from photoprinting with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. A __________ is a photographic print made by placing the negative and printing paper in direct contact for exposure.

_____ 2. A __________ is a positive image on photographic paper.

_____ 3. __________ is the degree of lightness or darkness in any given area of a print.

_____ 4. The __________ of a print is the shades of white in the finished print and is controlled by the color of the paper.

_____ 5. __________ paper can have its contrast changed by using filters calibrated in contrast grades.

A. Print

B. Tint

C. Contact Print

D. Variable Contrast

E. Tone

ENLARGING TERMS

Match the terms from enlarging with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. A print that is larger than the negative or slide.

_____ 2. The degree of lightness or darkness in any area of a print.

_____ 3. Holding back light from the projected image during exposure time so that the photographic paper receives less than normal exposure in areas that were too dark in the straight print.

_____ 4. Giving additional exposure to part of the image projected on an enlarger easel to make that area of the print darker.

_____ 5. Softening detail in a print with a diffusing disk or other material that scatters light.

A. Tone

B. Diffusion

C. Burning in

D. Enlargement

E. Dodging

Match the terms with the description which best describes the term. Place the letter of your answer in the blank before each statement.

_____ 1. The thickness of photographic paper is its __________.

_____ 2. The __________ is the number telling the amount of contrast that can be expected with that paper.

_____ 3. The __________ of the paper is its sensitivity to light.

_____ 4. __________ is the roughness of the paper which determines how the paper reproduces the fine details from a negative.

A. Texture

B. Weight

C. Speed

D. Contrast Grade

PRE-TEST ANSWERS

1. E
2. F
3. A
4. F
5. B
6. C
7. H
8. D
9. I
10. M
11. J
12. K
13. N
14. L
15. O

Eyeball (Whole)--Camera Box

Iris--Camera diaphram

Eyelid--Shutter

A. Self timer lever
B. Flash Terminal
C. Hot Shoe
D. Preview Button
E. Shutter release
F. Film advance lever
G. Viewfinder
H. Shutter Speed Dial
I. Rewind Knob
J. Lens

Developing Terms.	Print Terms:
1.--C	1.--C
2.--A	2.--A
3.--E	3.--E
4.--B	4.--B
5.--D	5.--D

Enlarging Terms:

1.--D

2.--A

3.--E

4.--C

5.--B

Photographic Paper Test:

1.--B

2.--D

3.--C

4.--A

MASTER EQUIPMENT AND SUPPLIES LIST

This list is for a class of 24 students.

I. Equipment

  A. 12--Utility knives
  B. 12--Pairs of scissors
  C. 02--35mm SLR Cameras
  D. 02--Electronic flashes
  E. 02--Tripods
  F. 02--Light meters
  G. 02--Shutter release cables
  H. 6--Film processing tanks
  I. 6--Darkroom Thermometers
  J. 6--Darkroom graduates
  K. 24--Spring-type clothespins
  L. 24--Large jars
  M. 6--Darkroom timers
  N. 6--Stirring rods
  O. 2--Changing bags
  P. 6--Printing frames with 7-watt light bulbs
  Q. 24--Trays 8 X 10 inches (Kodak Duraflex)
  R. 1--Safelight (if you do not have one in a darkroom)
  S. 6--Enlarger easels
  T. 6--Enlarge[illegible]
  U. 6--Camel's hair brushes
  V. 6--Rubber squeegees
  W. 8--Sets of filters for above cameras
  X. 6--Self-developing cameras
  Y. 6--Instant type cameras
  Z. 24--*Kodak Pocket Guide To Good Pictures*

II. Supplies

A. 12--Cartridges of 126 Film (Kodak Tri-X Pan)

B. 12--Pieces of thin black cardboard, 1 1/4" X 5 3/4"

C. 12--Pieces of rigid black cardboard, 1 1/2" X 2 3/4" with a 1/2" square opening cut in center

D. 12--Pieces of heavy aluminum foil, 1 inch square

E. 12--Pieces of black paper, 1 inch square

F. 12--Wooden tongue depressors

G. 24--Strong rubber bands

H. 12--No. 10 sewing needles

I. 1--Roll of black masking tape

J. 4--Bottles of lens cleaning fluid

K. 4--Packages of lens cleaning tissue

L. 06--Rolls of Panatomic-X Film

M. 06--Rolls of Plus-X Pan Film

N. 06--Rolls of Tri-X Pan Film

O. Four gallons of Kodak Developer D-76

P. Four gallons of Kodak Indicator Stop Bath

Q. Four gallons of Kodak Fixer of KodaFix Solution

R. 300-Sheets (12 packages) of Kodak Polycontrast Rapid RC Paper, 8 X 10 inches.

S. Four gallons of Kodak Dektol Developer

T. 1--Cartridge self-developing film

U. 1--cartridge instant 110 or 126 film

TENNESSEE INDUSTRIAL ARTS CURRICULUM

U.S.O.E. Career Cluster:

COMMUNICATIONS

Occupational Family:

PHOTOGRAPHY

NATURE OF WORK

Photographers use their cameras and film to portray people, places, and events much as a writer uses words. Those who are skillful can capture the personality of individuals or the mood of scenes which they photograph. Although their subject matter varies widely, all photographers use the same basic equipment. The most important piece, of course, is the camera, and most photographers own several. Professional cameras use a variety of lenses designed for close-up, medium-range, or distance photography.

Besides cameras and lenses, photographers use a variety of film and colored filters to obtain the desired effect under different lighting conditions. When taking pictures indoors or after dark, they use electronic flash units, floodlights, reflectors, and other special lighting equipment.

Some photographers develop and print their own photographs in the darkroom and may enlarge or otherwise alter the basic image. Many photographers send their work to photographic laboratories for processing.

Many photographers specialize in a particular type of photography, such as portrait, commercial, or industrial work. Portrait photographers take pictures of individuals or groups of persons or groups of persons and often work in their own studios. For special events, such as weddings or christenings, however, they take photographs in churches and homes. Commercial photographers photograph a wide range of subjects including livestock, manufactured articles, buildings, and large groups of people. They frequently do photography for catalogs. Advertising photographers must know how to use many different techniques. The work of industrial photographers is used in company publications to report to stockholders or to advertise company products or services. They also photograph groups of people for employee news magazines.

ANALYSIS OF JOB PREREQUISITES

Photographic training is available in colleges, universities, junior colleges, and art schools. Although a high school education is desirable, the photography profession has no set entry requirements with regard to formal education or training. Photographers must have good eyesight and color vision, artistic ability, and manual dexterity. They also should be patient and accurate and enjoy working with detail. Some knowledge of mathematics, physics, and chemistry is helpful for understanding the use of various lenses, films, light sources, and development processes. Photographers must be imaginative and original in their thinking. The portrait photographer needs the ability to help people relax in front of the camera.

ANALYSIS OF JOB ATTRIBUTES

Over 75 colleges and universities, junior colleges, and art schools offer four-year curriculums leading to a bachelor's degree in photography. Some colleges have a two-year curriculum leading to a certificate or associate degree in photography. Art schools offer useful training in design and composition. The Armed Forces also train many young people in photographic skills. People may prepare for work as photographers in a commercial studio through two or three years of on-the-job training as a photographer's assistant. Trainees generally start in the darkroom where they learn to mix chemicals, develop film, and do photoprinting and enlarging. Later they may set up lights and cameras or help an experienced photographer take pictures.

Photographers with exceptional ability may gain national recognition for their work and exhibit their photographs in art and photographic galleries, or publish them in books. A few industrial photographers may be promoted to supervisory positions. Magazine and new photographers may eventually become heads or graphic arts departments or photography editors.

Employment of photographers is expected to grow more slowly than the average for all occupations through the mid-1980's. In addition to openings, resulting from growth, others will occur each year as workers die, retire, or transfer to other occupations. Photography is becoming an increasingly important part of law enforcement work, as well as scientific and medical research, where opportunities are expected to be good for those possessing a highly specialized background. The employment of portrait and commercial photographers is expected to grow slowly, and competition for jobs as portrait and commercial photographers is expected to be keen.

Photographers who have salaried jobs usually work a 5-day, 35-40 hour week and receive benefits such as paid holidays, vacations, and sick leave. Those in business for themselves usually work longer hours. Freelance, press, and commercial photographers travel frequently and may have to work in uncomfortable surroundings. Sometimes the work can be dangerous, especially for news photographers assigned to cover stories on natural disasters or military conflicts.

Newspaper photographers with some experience (usually four or five years) averaged about $320 a week in 1976. Almost all experienced newspaper photographers earned over $225; the top salary was nearly $505 a week. Experienced photographers generally earn salaries that are above the average for non-supervisory workers in private industry, except farming. Although self-employed and freelance photographers often earn more than salaried workers, their earnings are affected greatly by general business conditions and the type and size of their community and clientele.

Job titles for this Instructional Program are:

Title	D.O.T.
Photographer	143.062.034
Aerial Photographer	143.062.014
Photographic Retoucher	970.281.018
Camera Repairer	714.281.014
Photo Spotter	970.381.034
Film Processing Supervisor	976.132.010
Automatic Developer	976.685.014
Print Cutter	976.685.010
Automatic Print Developer	976.685.026
Film Processing Utility Work	976.685.030
Color-Printer Operator	976.382.014
Film Developer	976.382.014
Black-and-White Printer Operator	976.682.014
Still Photographer	143.062.030
Finish Photographer	143.382.014
Developer	976.681.010
Photo Finisher	976.487.010
Photographer Helper	976.667.010
School Photographs Detailer	976.564.010
Finishing Department Supervisor	976.137.014
Quality-Control Technician	976.261.010
Print Controller	976.360.010
Reproduction Technician	976.361.010
Print Washer	976.684.022
Photofinishing Laboratory Worker	976.687.018
Photo Checker and Assembler	976.687.014
Print Inspector	976.687.022

SOURCES OF ADDITIONAL INFORMATION

Photographic Art and Science Foundation
111 Stratford Rd.
Des Plaines, Ill 60016

Professional Photographer of America, Inc.
1090 Executive Way
Des Plaines, Ill 60018

JS PH 4

Dictionary of Occupational Titles, Fourth Edition, 1977.

Occupational Outlook Handbook, 1978-79 Edition.

Encyclopedia of Careers and Vocational Guidance, 1978 Edition.

GUIDE - Worker Trait Group, 1978.

COMMUNICATIONS

JOB STRUCTURE: PHOTOGRAPHY

JOB TITLE: Aerial Photographer D.O.T. No.: 143 062 014

Major Job Function:

Photographs segments of earth and other subject material from aircraft to produce pictures used in surveying, mapping, and related purposes such as recording effects of pollution or natural disasters, determining condition of crops and timberland, and planning cities or other large scale projects.

Job Duties:

1. Sets up and mounts camera in aircraft.

2. Confers with pilot regarding plotted course, speed, altitude, and area to be photographed.

3. Communicated with pilot during flight to insure adherance to flight plan or make adjustments to equipment to compensate for changes.

4. Calculates number of exposures and time lapse between them, using standard formulas to determine requirements for adequate area coverage.

5. Adjusts camera shutter speed, lens aperature opening, and focus.

6. Adjusts automatic exposure interval on camera equipped with time lapse control or times intervals with stopwatch and manually trips shutter.

7. Maintains camera in level position and oriented to flight path when making photographs for mapping or surveying.

JOB TITLE: Still Photographer D.O.T. No.: 143 062 030

Major Job Function:

Photographs subjects using still camera, color or black-and-white film, and a variety of photographic accessories.

Job Duties:

1. Selects and assembles equipment according to subject material, anticipated conditions, and knowledge of function and limitations of various types of cameras, lenses, films, and accessories.
2. Views subject and setting and plans composition, camera position, and camera angle to produce desired effect.
3. Arranges subject material, poses subject, or maneuvers into position to take candid photo.
4. Estimates or measures light level, using light meter or creates artificial lighting with flash units, lights, and lighting equipment.
5. Adjusts lens aperture and shutter speed based on combination of factors, such as lighting, depth of field, subject motion, and film speed.
6. Determines subject to lens distance, using tape measure, range finder, ground glass, or reflex viewing system to adjust focus.
7. Positions camera and trips shutter to expose film.

JOB TITLE: Photographer D.O.T. No.: 143 062 034

Major Job Function:

Photographs people, events, location, or other illustrative or educational materials for amusement and recreation or for use in publications or telecasts, using still cameras.

Job Duties:

1. Travels to assigned location and takes pictures.
2. Develops negatives and prints film.
3. Submits negatives and pictures to customers or to editorial personnel.
4. Takes portraits by use of lighting arrangements to achieve different effects.

Photographer Job Duties (continued):

5. Works in studio or may go to home of individual to make a special portrait.

6. May specialize in one phase of photography, as news, sports, special features, or as a freelance photographer.

JOB TITLE: Finish Photographer D.O.T. No.: 143 382 014

Major Job Function:

Operates photographic equipment to photograph finish of horse race.

Job Duties:

1. Loads film into camera and advances to picture taking position.
2. Sights camera on finish line and adjusts exposure controls and focus.
3. Observes race and starts camera as horses approach finish line.
4. Stops camera after last horse has crossed finish line.
5. Removes exposed film from camera and places it into film-developing machine that automatically develops film.
6. Prints and enlarges photographs used to determine winner of race when finish is close.

JOB TITLE: Photographic Retoucher D.O.T. No.: 970 281 01J

Major Job Function:

Retouches photographic negatives and prints to accentuate desirable features of subjects, using pencils or watercolors and brushes.

Job Duties:

1. Examines negative to determine which features should be accentuated or minimized.

Photographic Retoucher Job Duties (continued):

2. Paints negative with retouching medium so that retouching pencil will mark surface of negative.

3. Shades negative with pencil to smooth facial contours, conceal stray hairs, wrinkles, or blemishes, and soften harsh highlights.

4. Brushes watercolors on print to accentuate lights and shadows and produce clear and attractive features.

JOB TITLE: Photo Spotter D.O.T. No.: 970 381 034

Major Job Function:

Covers or spots out imperfections on photographic prints, using gloved finger, brush, or pencil.

Job Duties:

1. Positions print under viewing light or on illuminated table and examines print to detect defects, such as surface blemishes, dust spots, and uneven margins.

2. Selects premixed paint or mixes paint, using color charts, when repairing color prints.

3. Applies paint to defective area of color print, using glove finger or artists' brush.

4. Shades light areas on black-and-white prints, using pencil.

5. Rubs surface of photograph with cloth to remove debris and reduce gloss.

6. Trims edges of print to enhance appearance, using scissors or paper cutter.

7. Places prints in customer bag and records number per bag or mounts print in specified frame.

JOB TITLE: Film Processing Supervisor D.O.T. No.: 976 132 010

Major Job Function:

Supervises and coordinates activities of workers engaged in photofinishing operations, such as preparing photographic negatives and paper, and developing, sorting, and checking prints.

Job Duties:

1. Trains new workers and demonstrates new techniques to improve skills of experienced workers.
2. Flips switches and turns controls on master panelboard to start photographic processing equipment, admit solutions to processing tanks, and to adjust solution temperature and flow rate.
3. Monitors operation of machionery and equipment to detect defective parts.
4. Repairs defects, such as loose nuts and bolts, and notifies maintenance department when major repairs are required.
5. May perform duties of subordinates to maintain production or to replace absent worker.
6. Performs other duties as described under Supervisor.

JOB TITLE: Finishing Department Supervisor D.O.T. No.: 976 137 014

Major Job Function:

Supervises and coordinates activities of workers engaged in cutting, checking, spotting, mounting, pricing, and packaging film negatives and prints to prepare orders for shipment.

Job Duties:

1. Plans and conducts training programs for new workers and to improve skills of experienced workers.
2. Inspects work in progress to verify consistency of workers' decisions with company standards.
3. Inspects equipment, makes minor adjustments, and confers with maintenance personnel to schedule major repairs.

Finishing Department Supervisor Job Duties (continued):

4. Reviews price listings of merchandise and indicates price changes on listings according to instructions from management.

5. Requisitions supplies according to worker requirements and records of supplies on hand.

JOB TITLE: Quality-Control Technician D.O.T. No.: 976 261 010

Major Job Function:

Examines photographic prints, processed film, cameras and other photographic equipment for defects or faulty operation to determine course of action required to satisfy customer complaints.

Job Duties:

1. Reviews unresolved requests for adjustment of complaints and reads customer comments to determine basis of complaints and plan of action needed to resolve complaint.

2. Spreads negatives and prints on illuminated worktable and uses magnifying glass to detect defects, such as incorrect coloring, shading, or cutting.

3. Determines cause of defect and type correction required based on knowledge of photo processing and finishing techniques.

4. Prepares memorandum to processing department and confers with supervisor to suggest remedies to prevent subsequent errors in processing.

5. Contacts customer to explain causes for defects and confers with sale-service personnel to resolve technical questions and to demonstrate correct usage of photographic equipment.

6. Prepares reports indicating complaints handled and dispositions made.

JOB TITLE: Print Controller D.O.T. No.: 976 360 010

Major Job Function:

Sets up and adjusts photographic print developing equipment according to density, color, and size of prints.

Job Duties:

1. Positions film in densitometer, reads dials, and records findings on plot sheet to locate defects in density and color balance.
2. Confers with Supervisor, Quality Control to determine adjustments required to bring print machine into balance.
3. Runs test film strip through print machine to evaluate machine exposure.
4. Removes cover from control panel of print machine to gain access to control shafts and adjustment knobs, using wrench.
5. Plugs electric timer into printer to determine time elapsed during printing operation.
6. Starts equipment, observes timer, and adjusts shafts and knobs to attain specified process settings, using handtools.
7. Locks control shafts of printer into position subsequent to final adjustment to prevent shifting in color or density balance during printing.
8. Keeps records of adjustments made for departmental use.

JOB TITLE: Reproduction Technician D.O.T. No.: 976 361 010

Major Job Function:

Duplicates printed material on sensitized paper, cloth, or film according to customer specifications, using photographic equipment and handtools.

Job Duties:

1. Reads work order and confers with supervisor to determine processes, techniques, equipment, and materials required.
2. Places original on sensitized material in vacuum frame.
3. Mounts camera on tripod or stand and loads prescribed type and size film in camera.
4. Sets camera control to regulate exposure time according to line density of original and type of sensitized material.
5. Activates camera to expose sensitized material, imprinting original on material.
6. Develops exposed material.
7. Examines developed reprint for defects, such as broken lines, spots, and blurs, and touches up defects, using chemicals, inks, brushes, and pens.

JOB TITLE: Color-Printer Operator D.O.T. No.: 976 382 014

Major Job Function:

Controls equipment to produce color prints from negatives.

Job Duties:

1. Reads customer instructions to determine processing requirement.
2. Loads roll of magazine of printing paper into color printing equipment.
3. Examines color negative to determine equipment control settings for production of prints meeting acceptable color-fidelity standards.
4. Sets controls in accordance with examination, loads negative into machine, and starts machine to produce specified number of prints.
5. Removes printed photographic paper from machine and places paper in film bag for further processing or in developing machine.
6. Inspects finished prints for defects, such as dust and smudges, and removes defects, using brush, cloth, and cleaning fluid.
7. Inserts processed negatives and prints into envelope for return to customer.

JOB TITLE: Film Developer D.O.T. No.: 976 382 018

Major Job Function:

Operates machine to develop still or motion-picture film.

Job Duties:

1. Pulls film strips through trapdoor into darkroom.
2. Examines film to determine type processing required, utilizing knowledge of film developing techniques.
3. Feels edges of film to detect trears and repairs film using hand stapler.
4. Mounts film in guide slot of developing machine according to length of time required for processing and pulls lever to lower film into processing position.
5. Flips switch to start machine that transports film through series of solutions and into drying cabinet to develop and dry film.
6. Observes film passing through machine to determine density of image and adjusts machine controls to shorten or lengthen path of film through solutions according to observation.

JOB TITLE: Photo Finisher D.O.T. No.: 976 487 010

Major Job Function:

Performs any combination of the following tasks to dry, trim, and mount photographic prints.

Job Duties:

1. Places washed print on conveyor leading to heated rotating cylinder that dries and flattens print.
2. Trims print edges, using paper cutter or scissors.
3. Inserts print in specified frame or mounts print on material, such as paper, cardboard, or fabric, using cement or hand-operated press.
4. Inserts print and corresponding negative in computer envelope.
5. Computes price of order, according to size and number of prints, and marks price on customer envelope.

JOB TITLE: School Photographs Detailer D.O.T. No.: 976 564 010

Major Job Function:

Performs a variety of tasks to prepare and disseminate school photographs.

Job Duties:

1. Reads photographers' work orders and records information, such as number of prints and type finish specified as a guide for processing film.
2. Assigns control number to each order.
3. Records customer charges on worksheet and submits to accounting department for billing.
4. Sorts and bags film according to processing required.
5. Cuts prints to prepare composite for group photographs, using chopping block, die, and mallet.
6. Assembles composite and mails to picture service for processing of negative.
7. Routes composite negative to printing section and records cost of composite service.
8. Feeds specified photographs in gluing machine that automatically applies adhesive backing to photographs.
9. Confers with photographers to resolve complaints regarding missing or defective photographs.
10. Cuts out, arranges, and paste letters, number, and pictures to design advertising circulars.
11. Maintains records indicating orders received, unit prices charged, and department earnings.

JOB TITLE: Photographer Helper D.O.T. No.: 976 667 010

Major Job Function:

Assists Still Photographer in taking and developing photographs.

Job Duties:

1. Arranges lights and screens, sets up camera at proper angle, and moves objects to secure desired background for photographs as directed.
2. Assists in darkroom duties, such as mixing chemical solutions and developing films.
3. Labels photographs.

JOB TITLE: Developer D.O.T. No.: 976 681 010

Major Job Function:

Develops exposed photographic film or sensitized paper in series of chemical and water baths to produce negative or positive prints.

Job Duties:

1. Mixing, developing and fixing solutions, following formula.
2. Immerses exposed film or photographic paper in developer solution to bring out latent image.
3. Immerses negative or paper in stop-bath to arrest developer action, in hyposolution to fix image, and in water to remove chemicals.
4. Dries prints or negatives, using sponge or squeegee, or places them in mechanical air drier.

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JOB TITLE: Black-and-White Printer Operator D.O.T. No.: 976 682 014

Major Job Function:

Operates printer to produce black-and-white photographic prints from negatives.

Job Duties:

1. Mounts roll of sensitized paper on spindle of printer and threads paper through guides, rollers, and onto take-up spindle.
2. Prepares batch identification sheet, positions sheet in printer, and activates printer to transfer information from sheet to sensitized paper.
3. Prints identification number on customer envelope, using stamping machine.
4. Remove negative strip or single negative from negative from envelope and cleans negatives to remove dust particles, using air blower or gloved finger.
5. Inserts negative in printer and examines image to determine whether picture setting is in or out-of-doors.
6. Activates printer and adjusts control knobs to produce photographic prints of required shading and density.
7. Places printed roll in envelope and seals envelope to prevent exposure to light.

JOB TITLE: Print Washer D.O.T. No.: 976 684 022

Major Job Function:

Washes and dries photographic prints, using print-washing pan and blotter, and wringer.

Job Duties:

1. Places developed prints in print-washing pan and activates mechanism that rotates pan to wash prints.

Print Washer Job Duties (continued):

2. Immerses prints in chemical solution subsequent to washing cycle to increase flexibility of prints.

3. Dries prints, using blotter, or positions prints on metal plates, and dries prints, using wringer.

4. Inserts prints in rack on open-faced frames to complete drying process.

5. May examine prints for stains and other defects and return defective prints to developing room.

JOB TITLE: Print Cutter D.O.T. No.: 976 685 010

Major Job Function:

Tends automatic or semi-automatic machines that cut processed film or prints into single or multiple units.

Job Duties:

1. Examines film or print roll to determine size, number of cuts required, and type machine to use.

2. Turns setscrews to adjust machine guides to roll width and sets density meter on automatic machine to coincide with sensitized marks on roll that control release of cutting blade.

3. Threads roll through machine guides and starts machine that automatically cuts roll into individual or multiple units or depresses pedal of semiautomatic machine to cut roll.

4. Cuts roll of non-standard width, using scissors or hand-operated paper cutter.

5. Inserts units in customer envelope.

6. Keeps production records.

JOB TITLE: Automatic Developer D.O.T. No.: 976 685 014

Major Job Function:

Tends machine that develops sheets, strips, or continuous roll of film preparatory to printing.

Job Duties:

1. Pulls film through trapdoor into darkroom.
2. Strips paper backing from film and attaches identifying label.
3. Feels edges of film to detect tears and repairs film, using stapler.
4. Reads work order or feels film for size or notches to determine type of process and developing time required.
5. Positions racks of film on machine chain links according to developing time required or threads leader of continuous roll through machine preparatory to processing.
6. Activates machine that automatically transports film through series of chemical baths to develop, fix, harden, bleach, and wash film.
7. Listens for sounds that indicate machine malfunctioning and notifies supervisor or maintenance personnel when repairs are needed.

JOB TITLE: Automatic Print Developer D.O.T. No.: 976 685 026

Major Job Function:

Tends one or more machines that automatically develop, fix, wash, and dry photographic prints.

Job Duties:

1. Threads leaders (paper strips) around rollers, through processing tanks and dryer, around polished drum, and onto takeup reel.
2. Turns valves to fill tanks with premixed solutions, such as developer, dyes, stop-baths, fixers, bleaches, and washes.

Automatic Print Developer Job Duties (continued):

3. Moves thermostatic control to keep steam-heated drum at specified temperature.
4. Splices sensitized paper to leaders, using tape.
5. Starts machine and throws switches to synchronize drive speeds of processing and drying units.
6. Compares processed prints with color standard and reports variation to control department.
7. Adds specified amounts of chemical to renew solutions.
8. Maintains production records.

JOB TITLE: Film Processing Utility Worker D.O.T. No.: 976 685 030

Major Job Function:

Performs a variety of tasks to assist or substitute for other workers in a photo-finishing laboratory.

Job Duties:

1. Sorts prints according to size and order number to facilitate handling.
2. Tends automatic cutting machine that cuts roll into individual prints (Cutter).
3. Tends automatic film developing machine that develops and fixes image on film (Developer, Automatic).
4. Removes prints from print developer rinse tray and tends drum-type drier that dries prints.
5. Prepares daily production sheet noting quantity and kind of work performed.

JOB TITLE: Photo Checker and Assembler D.O.T. No.: 976 687 014

Major Job Function:

Inspects, assembles, and packs mounted or unmounted negatives, color film transparencies, and photographic prints.

Job Duties:

1. Examines items for natural color shading density, sharpness of image, or identifying numbers, using lighted viewing screen.
2. Marks defective prints, using grease pencil and standardized symbols to indicate nature of defect and corrective action required in reprinting.
3. Removes defects, such as dust and smudges from prints, using brush, cloth, and cleaning fluid.
4. Packages and labels satisfactory prints and negatives.
5. Maintains daily production records.

JOB TITLE: Photofinishing Laboratory Worker D.O.T. No.: 976 687 018

Major Job Function:

Performs any combination of following tasks to prepare and disseminate negatives, positives, and prints in photofinishing laboratory.

Job Duties:

1. Reads instructions written on orders, and examines contents of orders to ascertain size, type, and number of pieces.
2. Sorts orders according to size and type processing equipment.
3. Pastes identifying label on customer order envelopes and transfer bags to insure matching of orders subsequent to processing.
4. Removes finished work from transfer bags subsequent to processing and computes customer charges according to price list.
5. Inserts order in bag or envelope, and staples bag together or seals envelope.
6. Pastes address label on bag or envelope.

JOB TITLE: Print Inspector D.O.T. No.: 976 687 022

Major Job Function:

Inspects photographic prints for defects, using film winder.

Job Duties:

1. Mounts roll of prints on spindle of film winder and tapes free end of film to crankshaft.
2. Turns crank and inspects prints for defects as film winds onto crankshaft.
3. Compares colors with standard image to insure that prints meet specifications.
4. Marks defective prints with code number, using chemical pencil, to indicate nature and degree of correction required.

JOB TITLE: Camera Repairer D.O.T. No.:

Major Job Function:

Repairs and adjusts cameras, using specialized tools and test devices.

Job Duties:

1. Disassembles camera, using handtools.
2. Tests and aligns diaphragm, lens mounts, and film transport to minimize optical distortion, using precision gauges.
3. adjusts range and view finders, using fixed focusing target.
4. Calibrates operation of shutter, diaphragm, and lens carriers with dial setting, using electronic or stroboscopic timing instruments.
5. Fabricates or modifies parts, using bench lathe, grinder, and drill press.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

GRAPHIC ARTS

Title of Unit:

INTRODUCTION

DESCRIPTION OF UNIT

This unit will cover the four basic methods of reproduction. It will give an overview of the uses, advantages and disadvantages. These materials are designed for five hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify the common methods of printing, list and discuss the advantages and disadvantages of each reproduction system, and compare and contrast the various printing reproduction systems in terms of application. Define graphic arts or graphic communications

PERFORMANCE OBJECTIVES

After completion of the unit the student will be able to:

1. List and describe the four basic methods of reproduction.
2. List advantages and disadvantages.
3. List common uses of each reproduction system.

OUTLINE OF CONTENT

I. Relief or Letter Press Printing

  A. Printing surface is raised above non-printing surface

  B. Surface may be hot type, linoleum blocks, stereotypes, electrotypes, or photo-engraved plates.

  C. Uses of letter press printing

    1. Newspaper

    2. Some textbooks

    3. Tickets

    4. Letterhead and envelopes

  D. Advantages and disadvantages of letterpress

    1. Straight type with no illustrations cheaper

    2. Good for details of illustrations

    3. Halftones cannot be used on rough paper

    4. Slower than gravure and offset

    5. Flexibility limited

II. Lithography or Planographic Printing

  A. Based on the principle that grease (ink) and water won't mix

  B. Printing from a flat surface

  C. Uses of lithography

    1. Bank checks and deposit slips

    2. Books

    3. Paper labels

    4. Metal containers

    5. Business forms

    6. General printing

D. Advantages and disadvantages

   1. Best for short or long runs with many illustrations
   2. Less time getting ready to print
   3. Storage for plates better than for letterpress
   4. High quality
   5. Economically feasible

III. Intaglio and Gravure Printing

A. Prints from an engraved surface instead of a raised surface as in relief

B. Uses of gravure

   1. Paper money
   2. Stamps and bonds
   3. Magazines
   4. Sunday newspaper supplements
   5. Food and candy wrappers

C. Advantages and disadvantages

   1. Suited for long runs (over 25,000) with many illustrations
   2. Cylinders last longer and presses run faster than other methods
   3. Fine detail lacking

IV. Silkscreen Printing

A. Basically a stencil process

B. Ink or paint is squeezed through a stencil mounted on silk, nylon, or organdy stretched tightly over a frame

C. Uses of screen printing

   1. Signs and posters
   2. Greeting cards
   3. Book covers

4. Art prints
5. Lamp shades
6. Charts and presentation books
7. Rugs and carpet
8. Bottles and other containers
9. Tumblers and glassware
10. Trays and placemats
11. Flocked products and simulated furs
12. Wallpaper and textiles
13. Decals
14. Printed circuits

D. Advantages and disadvantages

1. Produces vivid color
2. Practical for short runs and for long runs when automatic equipment is used
3. Used to print on odd shaped containers
4. Presses run slowly; much production done by hand

TEACHER ACTIVITIES

1. Provide student with student module.
2. Discuss outline of content and specific objectives.
3. Discuss information sheets and outline of content.
4. Give test

STUDENT ACTIVITIES

1. Read objective sheet.
2. Study outline of content.
3. Study information sheets.
4. Take Test.

REFERENCES/RESOURCES

Kansas State Dept. of Education, The CBIE Project--A cooperative Curriculum Effort in the Area of Visual Communication.

Information Sheet #1

TYPES OF GRAPHIC COMMUNICATIONS

Graphic communications is primarily concerned with sight. However sound, touch and smell are playing an increasingly important role. The key word "graphic", comes from the Greek "graphein," meaning to write. Writing is properly extended in this case to include drawings and paintings. It also includes "drawings produced by light" or photography. ("Photo" means "light" in Greek.)

So now we can say that graphic communications are messages received by the eye. These messages are about ideas, knowledge, and information. They can be in the form of writing, drawing, or photography. They can be reproduced on many types of materials, singly or in unlimited numbers. They can be reproduced immediately and/or on any later occasion.

This means that books, magazines and newspapers are part of graphic communications. Both the writing and the illustrations are included. Can you imagine a world without this type of communication? It means road maps and road signs. It includes the writing and the pictures on boxes, tubes, jars, cans and plastic packages for food, drugs, clothing, and almost everything else made. It includes posters for billboards, and many catalogs and leaflets. It also means currency (money), stamps, reproductions of paintings. The list could go on and on. Graphic communications is everywhere about us.

INDUSTRIES IN GRAPHIC COMMUNICATIONS

What is the graphic communications industry, or "industries" as some prefer to call it? First of all, graphic communications is made up of a large number of different but related industries. They produce an enormous variety of totally different products.

Chief among these is the printing, publishing, and packaging industry. In a group of the 20 largest manufacturing industries, printing, publishing, and packaging is the largest. It is the seventh largest total payroll. It is eighth largest in total number of employees.

However, a more important fact for students who are selecting a career is this: Printing and publishing is a growth industry. This means that printing and publishing is growing in the amount of business done each year. It also means that it is growing at a higher rate than the country's total production.

In addition to printing and publishing, graphic communications also includes:

1. The paper and paper products industry
2. The packaging industry
3. The coatings industry
4. The printing ink industry
5. The printing machinery manufacturing industry
6. The graphic arts supply industry

7. The production aspects of journalism, public relations, and advertising industries
8. The bindery industry
9. The electronics industry
10. The distribution industry
11. The chemical industry
12. The photographic industry

These, then, make up the graphic arts communications industries. These various industries within graphic communications are in the midst of the greatest challenge of the greatest technological revolution. The future in the graphic communications industries is going to be described by one word: change.

CHANGES IN THE GRAPHICS COMMUNICATION INDUSTRY

Graphic communications is rapidly moving from craft to science. Computers have been introduced into the setting of type. They can set the type used in an entire newspaper page in just a few minutes. Conventional methods use many hours. Other new type setting machines are being sold today. With these new machines, the setting of type is being measured, per line of type, in microseconds (millionths of a second). New photographic materials and processes are being developed and put on the market every few months.

Words and illustraitons may soon be sent by laser beams directly to the surfaces of image carriers. They may be sent by control of the laser beam through a combination of optics and electronics. Laser beams are fine beams of red light. This process is now in an advanced research stage. The market for the end products (magazines, packages, and so forth) of graphic communications has been rising on a geometric scale. In part, this is a result of the rise in population. It is also a result of the great achievement in the United States of providing free public education for everyone.

There are many reasons for the continuing increase in the amount of printed material. But the simple fact of the increase can be easily understood by the observant person.

There are career opportunities in graphic communications at all levels for young men and women of all interests and talents. The graphic communications industries will need in the years ahead persons to operate new machines and to use new techniques and materials.

Now, let us take a closer look at some jobs in the graphic communications industries.

THE PRINTING INDUSTRY

Printing is called an art. It is also a leading industry. It is one of our chief means of communication. It is very important in a country in which everyone is expected to read.

In 1970 the printing industry employed over 1 million people in a wide variety of jobs. Most of these jobs were in the printing, publishing, and related industries. Some of the jobs were located in government agencies and in private firms. For example, banks and insurance companies do their own printing or hire specialists to do it.

About one-third of all printing employees work in printing craft occupations. These craft occupations will be explained later. Occupations in the printing industries including printing estimator, printing technician, mailer, computer programmer, and computer typist. They also include the usual clerical, administrative, maintenance and sales jobs found in all industries.

NATURE AND LOCATION OF THE PRINTING INDUSTRY

The printing process is basically a means of transferring ink impressions of words, numerals, symbols, and photographs or other illustrations to paper, metal or other materials. The most commonly used methods of printing are: letterpress, flexography, lithography, gravure, screen printing.

Ech of these methods has a special skill associated with it. People must be trained to accomplish a good job each time they work. In 1970 the largest division in terms of employment was newspaper printing and publishing. There were over 370,000 people working in about 8,000 different printing firms. Most daily newspapers in the country print their own paper. They may have up to 2,000 employees. Most weekly and daily newspapers will have less than 20 employees.

Commercial or job printing firms were the second largest printing division. They used about 355,000 people in about 19,000 plants. This particular division produces advertising materials, letterheads, business cards, calendars, catalogs, labels, maps, and pamphlets. They may also printed limited quantities of newspapers, books and magazines. More than one-half of those employed in comercial or job printing work in shops with less than 100 employees. There are those exceptions, however, where large firms use over 100 people.

Almost every town in the country has a print shop. Some of them are weekly newspapers, which take on other printing jobs to keep the presses running. More than one-half of the people employed in printing are located in five states: New York, Illinois, California, Pennsylvania, and Ohio. Most of the printing plants are located near cities that have large popultions. These are places such as New York City, Chicago, Los Angeles, Philadelphia, San Francisco-Oakland, Cincinnati, and Cleveland. Book and magazine printing are highly concentrated in these areas. There are some other large employment areas for printers.

PRINTING OCCUPATIONS

Production of printer materials involves workers in a wide variety of jobs. Printing skilled workers numbered about 400,000 in 1970. They represent a large portion of the printing occupations. They usually specialize in one area of printing operations (for instance, typesetting, photography, platemaking, presswork, or binding.) Their training, moreover, is confined largely to only one of the basic printing methods--letterpress, lithography, or gravure.

The largest group of skilled workers are the composing room workers. There were about 185,000 of them in 1970. This group includes hand compositors, typesetting machine operators, makeup people, tape-perforating machine operators.

Other large groups of skilled workers are printing press workers and their assistants, lithographic skilled workers, including camera operators, artists, strippers, platemakers, and lithographic pressworkers. Some of the other important printing skilled workers are bockbinders, photoengravers, electrotypers, and stereotypers.

MACHINE MAINTENANCE

A number of different trades are employed in the maintaining of machines that produce copy and actually do printing. For instance, maintenance machinists repair and adjust typesetting machines, printing presses, or bindery equipment. They are usually found working in large plants. In most of the smaller plants the owner may hire someone to do the work whenever it is needed.

SKILLED OCCUPATIONS

Most of the skilled occupations use men. Practically all these occupations are filled by men. However, many of the less skilled jobs, especially in the binderies, are filled by women. This is changing as women are becoming more skilled and interested in these high paying jobs.

Printing equipment used today is becoming more complex and mechanized. Because of this, the need is growing for technically trained people in all areas of printing. An increasing number of production technicians are being employed throughout the printing industry. These people are responsible for seeing that the standards established for printing each job are met. Many of these people acquire experience working in small shops and then move on to larger companies.

TRAINING REQUIREMENTS

Apprenticeship is a common method of getting a start in the printing crafts. In some cases, it is the only means by which a person may be trained to become a journeyman* (skilled worker) in a unionized shop. A formal program of apprenticeship is required for journeyman status in many larger establishments that are not unionized.

In 1970 there were about 13,800 apprentices registered and in training in the skilled printing crafts. A registered apprentice is an employee, who, under an agreement, receives instruction in a specific occupation for a specified period of time. The apprentice is registered with a state apprenticeship agency or the U.S. Dept. of Labor's Bureau of Apprenticeship and Training.

Apprenticeships for the printing trades usually last from 4 to 6 years. The program covers all sides of the particular trade. It generally includes classroom or correspondence study courses. The materials studied is directly related to the job being done at the time. As new printing methods are developed and introduced, they generally are included in the duties of the traditional printing crafts and in the apprenticeship program.

Apprentices are usually required to be between 18 and 30 years old. They must pass a physical examination. There is, however, no age limit (maximum) for entering many of the printing crafts apprenticeship programs.

Most employers require a high school diploma or an equivalent education program, for entry into the apprenticeship program. A thorough knowledge of spelling, punctuation, the fundamentals of grammar, and basic mathematics is essential in many of the printing trades. a knowledge of the basic principles of chemistry, electronics, and physics is becoming increasingly more important because of the growing use of photomechanical and electronic processes in printing. An artistic sense is also an asset, since the finished product should be pleasing in balance and design.

Most printing crafts require persons with good eyesight, about average physical strength, and a high degree of manual dexterity.

Mental alertness, speed combined with accuracy, neatness, patience and the ability to work with others are also necessary. The ability to tell the difference between colors is important in those areas of printing in which color is used. Many employers require applicants to take one or more aptitude tests. These were developed for the printing industry occupations by the US Dept. of Labor.

These tests are given in the local offices of the state employment services. Apprentices often are chosen from among young people employed in various unskilled jobs in the printing establishments. They should be people who demonstrate the mechanical aptitudes needed for the printing crafts.

There are about 4,000 schools (high schools, vocational schools, technical institutes, and colleges) that offer courses in printing. These courses help you to be selected for apprenticeships or other openings in the printing and publishing industries.

COMMUNICATIONS CAREERS

The communication field requires a number of highly trained and specialized people. These jobs in particular, require people with special skills or training.

The future of communications jobs will continue to be bright. More and more people will have to be trained to keep present equipment operating. New technological improvements will demand retraining of persons in some fields. This means that persons who work in this field will have to be willing to accept a lifetime of training and on the job instruction. It is not an area in which a person can be trained and expect to use the same kind of skills forever.

The communications field will continue to offer opportunities to those who want to improve their minds and skills. It will continue to move ahead with the demands of a changing society. It will present young people with challenges and ideal working conditions. It offers something to everyone interested in becoming something better than they are at the present. It offers the chance for those who are willing to move up and become more skilled or better paid.

You are limited only by your ambitions and ability in this field.

Drafting technicians may be involved in a number of steps in the development of a product, house, or bridge. If it is to be built, they must communicate the ideas of the engineer and designer to the people who will be doing the building. The job of a drafting technician is very important. It may cost millions of dollars to correct the damage done by a wrong dimension.

Drafting technicians may be in on the development of a project from the start. However, if the job is a large building or product, a technician may be given only a small portion to work up. A plan must be developed and a design must be produced in most instances.

GA 1.14

GRAPHIC ARTS

The graphic arts concern work with printed matter. The printing industry turns out billions of dollars worth of printed materials every year. Printing is done on paper, wood, glass, cloth, rubber, metal, plastic and leather.

Printing can be done by a number of methods, but there are five major printing processes:

1. letterpress
2. gravure
3. screen
4. engraving
5. offset

In any study of the jobs in the printing industry you must take into account the many processes used in making a copy. The printer is considered a skilled person. It takes a large degree of skill to operate modern machines and to make sure no problems come up to delay the printing process. There are a number of processes in printing. Each one is necessary to the whole. A mistake can cost money.

Publishing is the process of making something public. Books, magazines, and newspapers are printed or published. A number of people with many skills are involved. A lot of people behind the scenes are not recognized. They have a job to do and they do it.

Newspapers use a number of "behind-the-scenes" people. They make sure the newspapers get out on time.

Magazines use highly skilled persons in many jobs. Good color pictures are hard to reproducxe thousands of times. Magazines need to be bound. Bindery jobs vary with the type of binding used to hold the magazines together. A closer look at these jobs will follow.

Image Transfer Devices

The technology of printed graphic communication is composed of several processes. Among these are image design, image composition, image preparation, and image transfer. Image transfer is the subject of this reading.

There are five basic processes involved in image transfer. They are letterpress, lithography, silk-screen, gravure, and electrostatic. All of these processes accomplish essentially the same thing--the transfer of an image from a carrier to a shet or roll of stock.

Letterpres printing is the oldest of the processes. The earliest form was done from wooden blocks in China about 868 A.D. Block printing spread to Europe and was first done there in 1377 A.D. The significant breakthrough in printing occurred in 1450 A.D. when Johann Gutenberg developed the process of printing from movable type.

Letterpress printing is the process of printing from a reversed, raised surface on an appropriate material (usually paper). The process involves the following sequence: preparation of the image carrier (type) inking of the image carrier; contacting the printing stock (paper) to the image carrier; application of pressure to the paper; and removal of the paper from the press.

There are several styles of letterpresses including: platen press; flatbed cylinder press; and rotary press. The platen press is probably the most common, however, the majority of production printing is accomplished with the cylinder press and the rotary press.

While most printed products can be printed with the letterpress, it is best suited to alphabetical material. Some of the most common products produced with the letterpress are: letterheads, envelopes, tickets, and office forms. However, some newspapers, textbooks, and advertising materials are still produced with the letterpress. It is not well suited to the reproduction of photographic types of material or to line drawings. As a result, most materials of this type are produced by other techniques

There are still many careers available to those desiring to enter the field of letterpress printing. Some of these are compositors (linotype operators, stonemen, etc.), layout men, proofreaders, pressmen, and bindery personnel.

Lithographic printing (also called offset lithography) is a rapidly expanding process in printed graphic communication. It is based on the principle that oil and water will not mix. As a result, the image carrier (plate) is prepared in a way that the printing image will accept ink and the non-printing surface will not. When water is applied to the plate, the inked surface repels the water while the non-inked surface accepts it. The inked plate is then contacted to a rubber blanket to reverse the image. Paper or other printing stock is then contacted to the blanket under pressure producing the printed material.

The basic principle (oil and water will not mix) was discovered, more or less by accident, by Alois Senefelder in 1798 while he was experimenting with printing from stone. As a result, early lithographic printing was done from stone blocks. (Thus, the name lithography--stone printing.) The process did not become widespread until the technique of offsetting the image onto another surface was discovered in 1904. The discovery of this process led to the rapid expansion of the process and to its common name today—offset printing.

Offset lithography is especially well suited to the printing of illustrated materials both photographic and line copy. The capability of offset lithography to reproduce photographs (halftones) is its principle advantage. As a result, it is commonly used to print newspapers, magazines, advertising materials, and other materials making extensive use of photographs. It is commonly used in office reproduction because of the ease of preparing short run image carriers with a typewriter.

There are two basic types of offset lithography printing presses. They are sheet fed presses and web fed (roll) presses. The web fed press is an extremely high production process and is commonly used for newspaper printing.

There are many careers available to those persons interested in entering the field of offset lithography including: layout and design workers, compositors, cameramen, strippers, platemakers, pressmen, and bindery workers. The skills required for certain careers in offset lithography are very sophisticated, and as a result, persons with these skills are very well paid.

Two additional image transfer processes are gravure printing and silk-screen printing. Gravure printing is used to produce treasury notes, stamps, some magazines, some newspapers, and some advertising material. Silk-screen is used for greeting cards, signs, lampshades, carpeting, bottles, wallpaper, and textiles. The outstanding characteristic of silk-screen printing is its adaptability to printing on irregular surfaces such as bottles and cans.

Gravure printing (also caled intaglio) prints from an image carrier with the printing areas depressed (the opposite of letterpress). The depressed areas act as ink wells and when printing stock is contacted to them under pressure a printed product results. It is used for treasury notes and stamps because of the difficulty of producing counterfeit material using the same process. Gravure presses are of two types, sheet fed and web fed.

The image carrier for silk-screen printing allows ink to pass through a porous material in the printing area. Printing stock is placed under the image carrier and ink is forced through the carrier onto the paper. Image carriers for silk-screen may be prepared by hand (stencils) or photographically. It is not a high production process and is best suited for special printing applications such as printing on irregular surfaces.

The most recently developed image transfer process is electrostatic printing. The process involves an electrically charged image carrier which positions the printing image on the carrier through magnetic forces. The printing stock is then contacted to the image carrier and fine pigmented particles are metered through the image carrier onto it. The process has been made famous by the Xerox Corporation and as a result it is commonly called xeroxing.

SUGGESTED TEST

Introduction to Graphic Arts

1. The four basic methods of reproduction are:

   a.

   b.

   c.

   d.

2. The reproduction process that is basically a stencil process is:

3. The reproduction process that prints from an engraved surface is called:

4. Which reproduction process is used to print paper money?

5. Which reproduction process is the oldest of the process?

GA 1.19

ANSWER SHEET

Suggested Test

1. Four basic reproduction methods are:

   A. Relief or letter press printing.
   B. Lithography or planographic printing.
   C. Intalgio and Gravure Printing
   D. Silk Screen Printing.

2. Silkscreen printing.

3. Intalgio printing

4. Intalgio printing

5. Relief or letter press printing

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

GRAPHIC ARTS

Title of Unit:

BLOCK PRINTING

DESCRIPTION OF UNIT

This unit covers basic block printing concepts. It gives an overview of the following areas: history of block printing, methods of block printing, uses of block printing, basic equipment, basic design transfer, and cutting and printing procedures. The materials in this unit are designed for 10 hours of instruction.

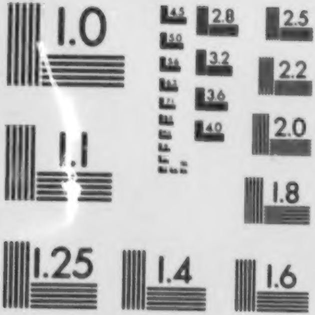
UNIT OBJECTIVE

After completion of this unit the student will be able to list the earliest uses of block printing, identify terms and definitions related to block printing, identify block printing equipment and their functions, discuss practical uses for block printing, and identify methods of block printing. The student will demonstrate the ability to transfer a design, cut, and print a linoleum block.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. List three early uses of the block print.
2. Define and describe terms and definitions.
3. List 3 methods of block printing.
4. Identify block printing equipment and give functions.
5. Discuss practical uses for block prints.
6. List advantages of linoleum over wood for block prints.
7. Demonstrate the ability to:
    A. Transfer design
    B. Cut linoleum block


1.0
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1.6

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS

STANDARD REFERENCE MATERIAL 1010a

(ANSI and ISO TEST CHART No. 2)

OUTLINE OF CONTENT

I. History of Block Printing

   A. Earliest Development - 1100 years before beginning of Christian era.

   B. Early Uses of Block Prints - Greeting cards, book covers, calendars, playing cards, pages of books, murals.
      Information sheet #1

II. Methods of Block Printing

   A. Wood Cut - Print made in fairly soft wood cut plankwise

   B. Linoleum Cut - Print made from a design cut in a piece of linoleum, mounted "type-high" for press.)

   C. Wood Engraving - Print made from a design cut in a piece of hardwood with a cross grain. (Transparency #1

   D. Plastic Engraving - Print made from plastic acetate on mylar. (TM #) (Student Activity Sheet #)

   E. Terms and Definitions (Information Sheet #2)

III. Uses of Block Printing (Information Sheet #1)

   A. Greeting Cards

   B. Book Covers

   C. Calendars

   D. Playing Cards

   E. Wall Paper

   F. Textile Prints

   G. Wall Hangings

   H. Posters

IV. Basic Equipment

   A. Wood or Battleship Linoleum Block--Wood or the one kind of linoleum suitable for block printing.

   B. Knife--Tool used for cutting wood cut or lino design.

   C. Gouges--Tool used for cutting wood cut design.

   D. Steel Square--Tool used for measuring and layout work.

   E. Tracing Paper/Carbon Paper

   F. Pencil

   G. Paper to Print On--Most paper is appropriate for printing.

   H. Block Print Ink--Ink used for a printing block.

   I. Brayer/Hand Press--Handroller or press used to transfer the ink from inking slab to block.

   J. Glass/Inking Slab--A piece of glass or plastic used to roll ink out on. (Information Sheet #2) (Transparency #2, 3)

V. Wood/Lino Cut Procedures

   A. Transfer Design--Tape design face down on block and trace all lines of drawing with pencil.

   B. Cut Design--Cut design with knife, leaving raised areas to be printed in black.

   C. Ink Design--Apply ink to the raised areas.

   D. Print Design--Place paper on ink surface of block and print.

   (Transparencies 2, 3, 4, 5) (Student Activity #1)
   (Demonstration #1)

VI. Acetate Film Etching Procedures

   A. Transfer Design

   B. Cut Design

   C. Ink Design

   D. Print Design

   (TM #) (Student Activity #)
   (Information Sheet #)

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and specific objectives.

IV. Discuss terms and definitions.

V. Perform Demonstration #

VI. Discuss information sheets and go through outline of material, giving demonstration.

VII. Give Test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study terms and definitions.

II. Study information sheets.

IIV. Complete Activity Sheets.

V. Take test.

REFERENCES/RESOURCES

I. References

A. Sprague, Curtiss, How to Make Linoleum Blocks, Bridgman Publishers, Inc., Pelham, New York.

B. Polk, Ralph W., Essentials of Linoleum Block Printing, The Manual Arts Press, Peoria, Illinois.

C. Saff, Donald/Sacilotto, Deli, Printmaking, History and Process, Holt, Reinhart, Winston, 1978.

D. Perry, Raymond W., Block Printing Craft, The Manual Arts Press, Peoria, Illinois.

II. Resources

A. Information Sheets

B. Transparency Masters

C. Activity/Demonstration Sheet

Information Sheet #1

HISTORY OF BLOCK PRINTING

Eleven-hundred years before the beginning of the Christian era the Chinese had reproduced many of their picture-writings in woodcut. This block art spread into Korea and Japan, where later it was developed to perfection.

Block printing on paper developed from the practice of printing designs on textiles from wooden blocks, which was a common practice throughout the Middle Ages.

Paper was not commonly used to print on before the early fifteenth century.

Early uses of the woodcut were greeting cards, initial letters, book covers, and playing cards.

The woodcut served the purpose of mural paintings which later developed into the manufacture of wall paper.

Before the invention of moveable type, the pages of books were printed from single blocks of wood with the text and illustration cut in relief.

Block printing is not confined to small work. Hand block wall paper and large wall hangings with hand-blocked printed designs are being used by interior designers.

While wood block printing probably lends itself as a better medium of expression for the experienced artist and craftsman, for the student, linoleum has many advantages over wood. Linoleum block printing is simple and lends itself to many applications. Linoleum is reasonable in cost, can be engraved with simple tools and printed with little equipment. It is also possible and practical to mount the engravings on blocks of wood, type high, and print on a flat bed press as many as 2,000 impressions before the linoleum begins to break down.

All prints may be divided into two large divisions: first, prints as a work of art and, second, all kinds of commercial prints. Under the first heading would be the wood and lino block prints, etchings, lithographs, mezzotints, and acquatints. The second division would embrace photographic prints and all types of photoengraving such as line cuts, halftone engraving and all forms of process color work.

GA 2.8

Information Sheet #2

TERMS AND DEFINITIONS

Apple, pear, cherry, sycamore, beech, sweetgum - Woods used in wood cut printing.

Battleship linoleum - The one kind of linoleum suitable for block printing.

Black and white print - Only one block is used from which design is cut and block rolled up in black ink.

Block printing - When the wood/linoleum is removed inside and about the design leaving it standing in relief about the block.

Boxwood - Wood most commonly used by wood engravers.

Brayer - Handroller used to transfer the ink from inking slab to block.

Burgin - Tool used by wood engravers.

Burnisher - Tool used in wood cut or lino printing to rub impression onto paper.

Chisels - Tools used for cutting wood cut or lino design.

Gouges - Tools used for cutting woodcut design.

Graven - Engraving tool.

Inking slab - Piece of glass or plastic to roll ink out on.

Knife - Tool used for cutting wood cut or lino design.

Lino-cut - Used as a modern substitute for wood for the cutting and making of block prints, the infant offspring of the woodcut. Economical, easily obtained and prepared and because it has no grain the tools cut with ease in all directions.

Tint tool - Engraving tool.

Woodcut - A print made in fairly soft wood cut plankwise.

Wood engraving - A print made from a design cut in a piece of hard wood with a cross grain. The image making methods resemble intaglio engraving, but printing is done in the same manner as for the woodcut.

Type-high - The body height of a piece of type if 0.918. It is very important to the printer that all type be exactly the same height in order to print evenly and consistently.

Information Sheet #3

GRAVURE PRINTING

Gravure printing (also called intaglio) prints from an image carrier with the printing areas depressed (the opposite of letterpress). The depressed areas act as ink wells and when printing stock is contacted to them under pressure a printed product results. It is used for treasury notes and stamps because of the difficulty of producing counterfit materials using the same process. Gravure presses are of two types, sheet fed and web fed.

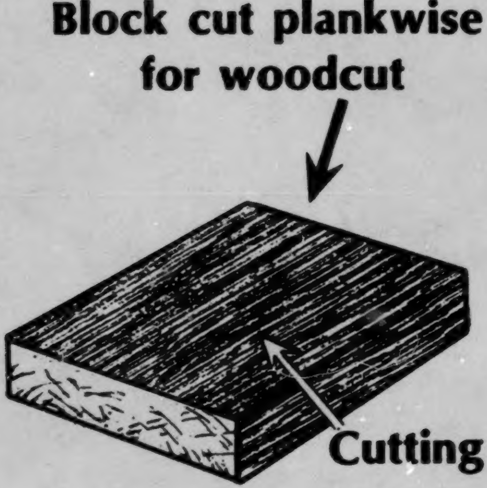
INTAGLIO PRINTING

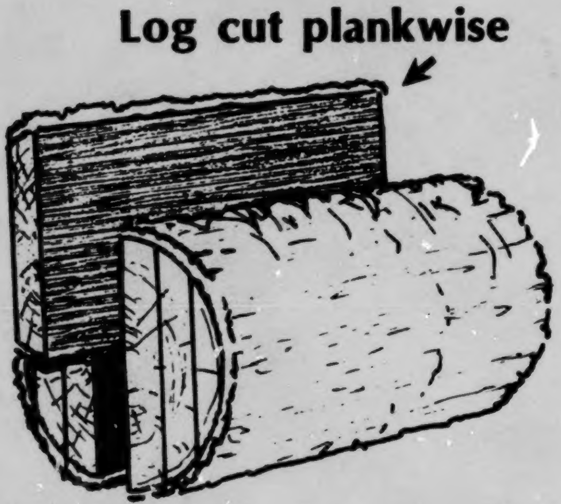
Wrinkle Printing

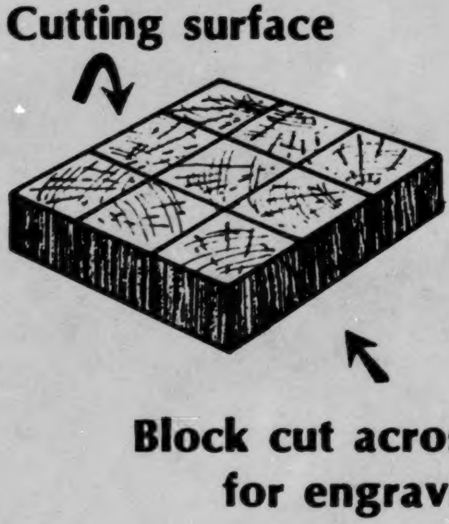
There are many unconventional methods and materials to prepare intaglio plates. For figurative prints and rough lettering you might try wrinkle printing. The essence of the process is this: a plate is coated with black wrinkle finish spray paint, which produces a rough texture that can hold etching ink in many tiny wells, evenly distributed across the surface. Portions of the rough surface are coated with white lacquer in varying thicknesses. The thicker the lacquer, the more the wells are filled up and the plate evened out. This means that parts of the plate become semi-smooth or very smooth. When the plate is coated with etching ink and wiped, the roughest parts, untouched by the white lacquer, will hold the greatest amount of ink and will print black. The semi-smooth parts will lose some ink in wiping, but will retain enough to print varying shades of gray. The very smooth parts will be wiped clean and will print white.

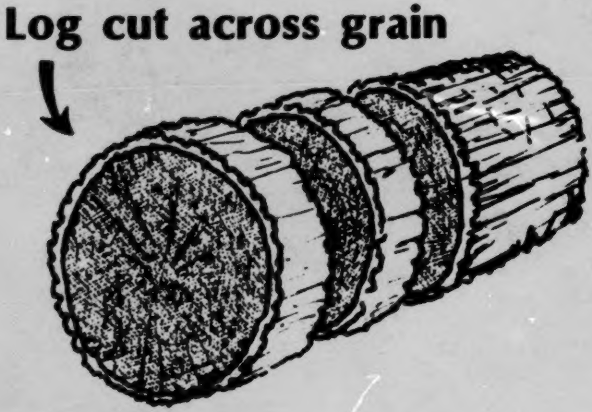
The plate is printed by the usual intaglio process. The inked plate is covered with a sheet of damp paper and passed through the etching press under pressure. When the paper is peeled away it literally pulls the ink from the wells or grooves. This process might me termed dry or direct, since they do not involve acids.

Since some budgets will not allow for the purchase of a press for use in a unit on intaglio printing, you might try to find an old hand run washing machine wringer, which can serve as an etching press.

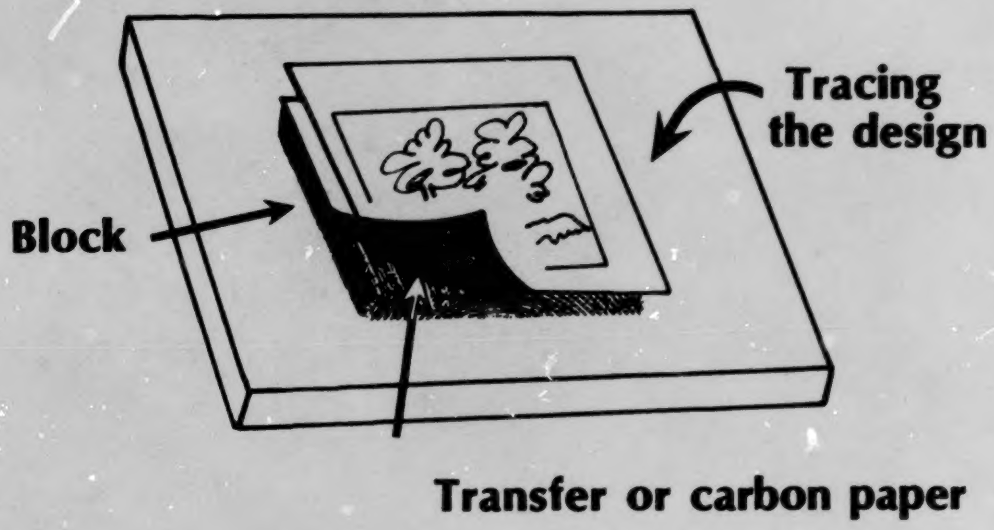

Block cut plankwise
for woodcut
Cutting surface

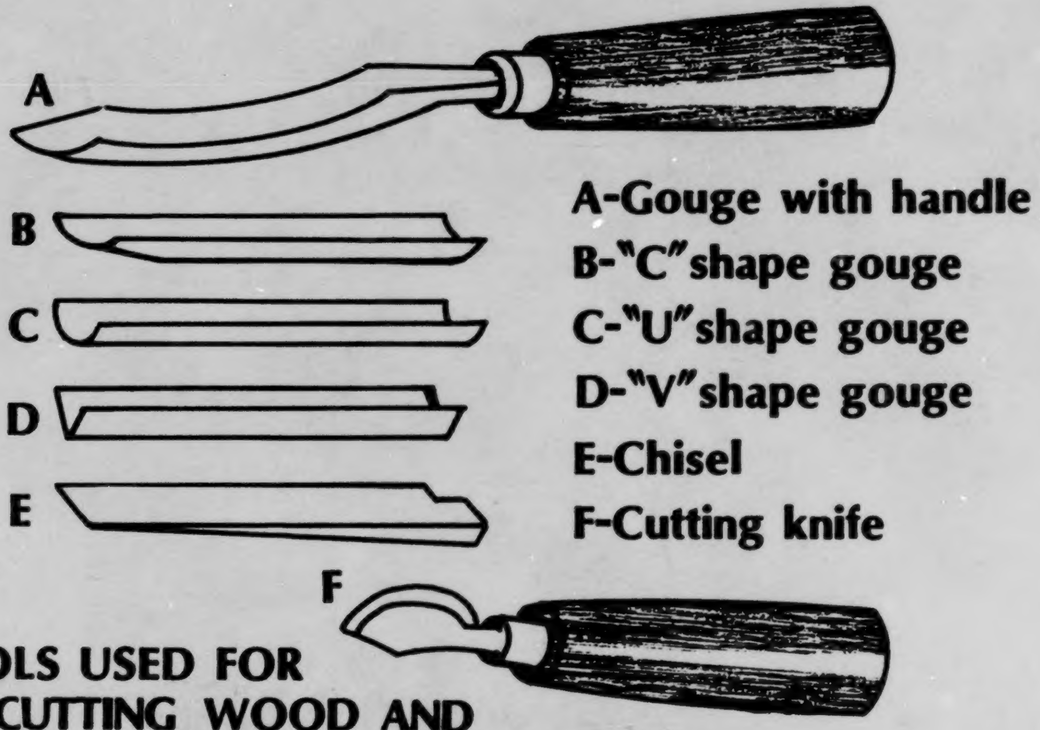

Log cut plankwise


Cutting surface
Block cut across grain
for engraving


Log cut across grain

TRANSFERRING THE DESIGN TO BLOCK

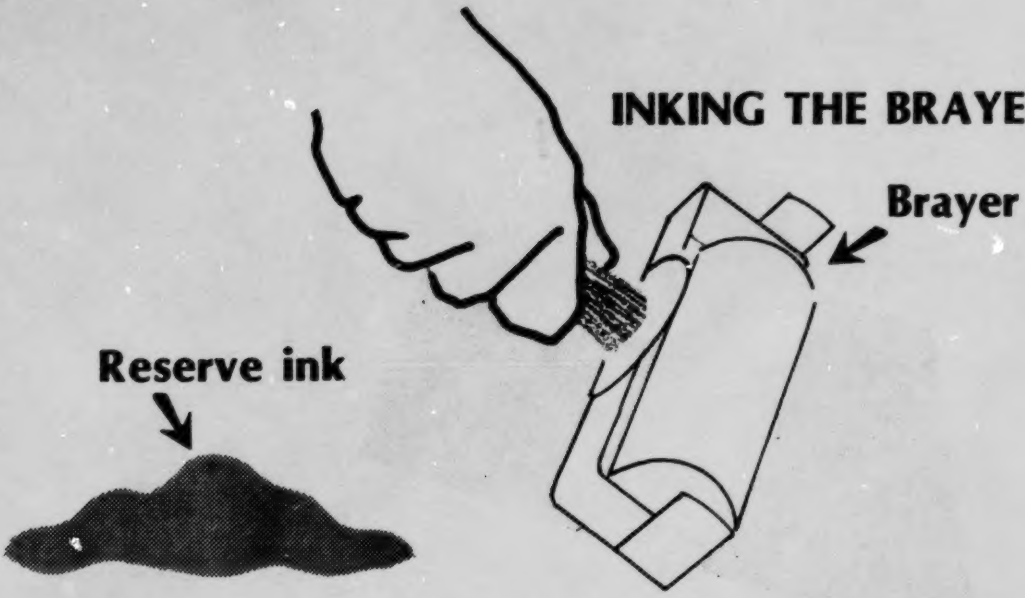

Tracing
the design
Block
Transfer or carbon paper



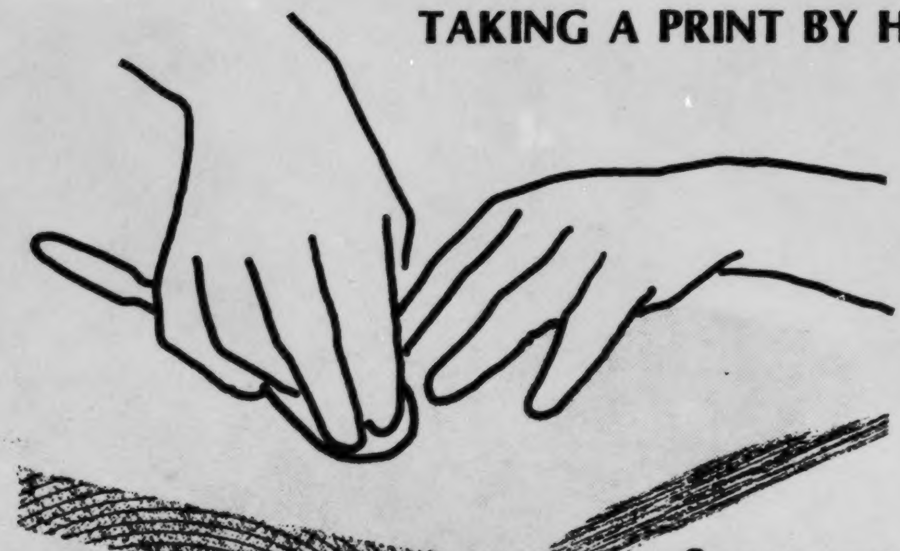
A-Gouge with handle
B-"C"shape gouge
C-"U"shape gouge
D-"V"shape gouge
E-Chisel
F-Cutting knife

TOOLS USED FOR CUTTING WOOD AND LINOLEUM BLOCKS

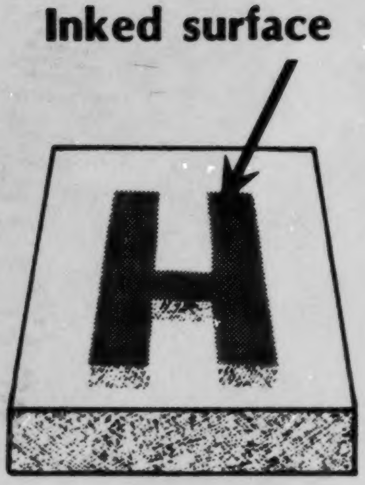
INKING THE BRAYER


Brayer
Reserve ink

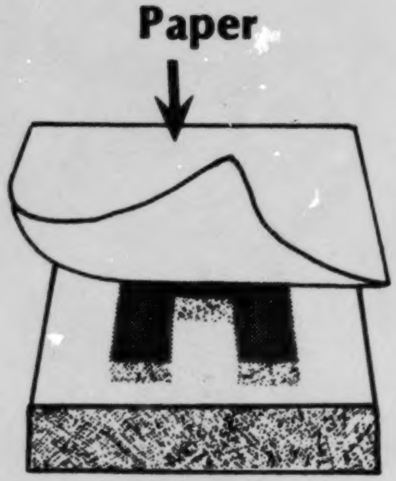
TAKING A PRINT BY HAND


Spoon used as burnisher

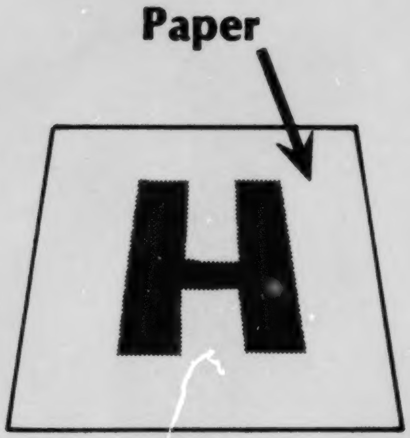
BLOCK PRINTING


Inked surface

Block showing design in relief

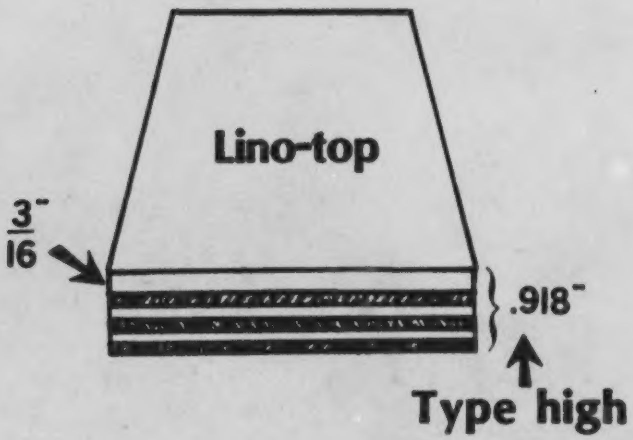


Paper laid on inked surface

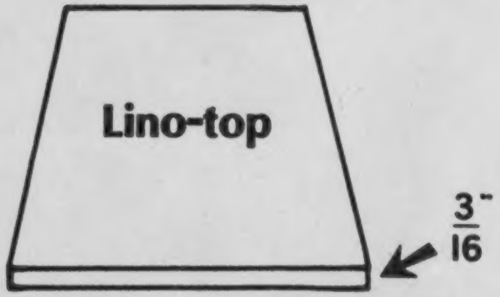


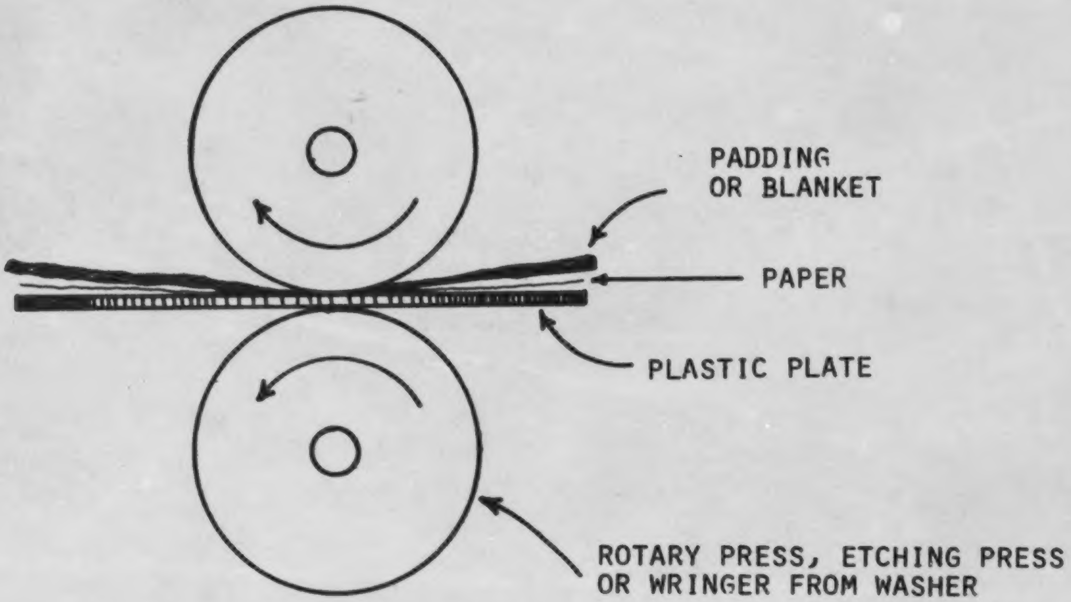
Impression from block

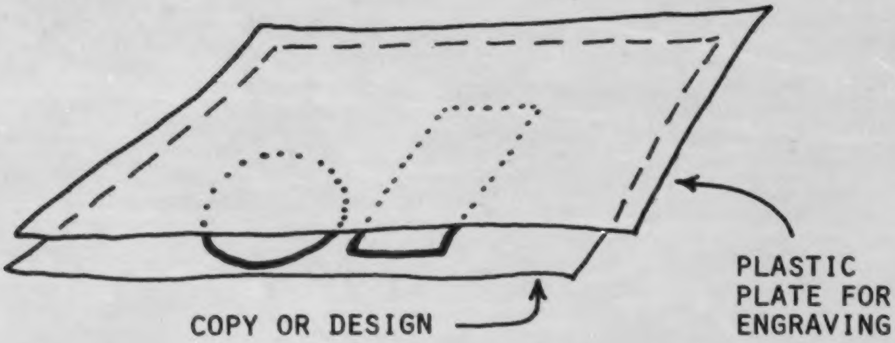
MOUNTED FOR POWER PRESS

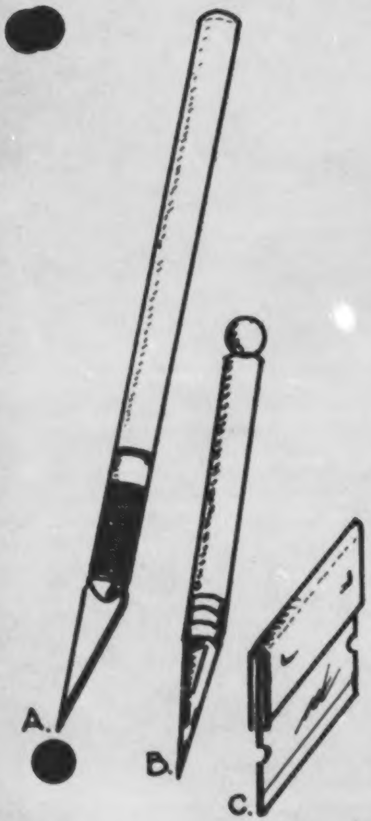

Lino-top
3"/16
.918"
Type high

UNMOUNTED


Lino-top
3"/16


PADDING
OR BLANKET
PAPER
PLASTIC PLATE
ROTARY PRESS, ETCHING PRESS
OR WRINGER FROM WASHER


PLASTIC
PLATE FOR
ENGRAVING
COPY OR DESIGN



A. X-ACTO KNIFE

B. BURIN

C. RAZOR BLADE

Teacher Demonstration #1

BASIC LINOLEUM BLOCK PRINTING PROCEDURES

I. Objective

Demonstrate basic procedures for transferring design, cutting linoleum block and printing a black and white or one color print.

II. Materials

1. Linoleum block
2. Knife
3. Gouges
4. Steel square
5. Tracing/carbon paper
6. Pencil
7. Paper to print on
8. Block printing ink
9. Brayer/hand press
10. Glass sheet
11. Minerals spirits
12. Burnisher
13. Spoon

III. Procedures

1. Tape a piece of transfer/carbon paper face down onto the linoleum block.
2. Tape the design face down on the carbon paper.
3. Trace all lines of drawing with a pencil.
    A. The drawing will be in reverse.
    B. After cutting and printing the block the print will appear as in the original design.
4. After tracing remove papers from block and black in all parts of the design not to be cut away.

5. Cut away all white areas leaving raised areas to print black.
6. Ink the brayer on the ink slab.
7. Roll a thin coating of ink over the raised surface of the block.
8. Place paper down onto the inked surface of the block.
9. Hold carefully with one hand and burnish with a burnisher or the bowl of a spoon.
10. Pull print away and repeat.
11. Clean block by wiping with rag soaked with mineral spirits.

Teacher Demonstration #1

BASIC LINOLEUM BLOCK PRINTING PROCEDURES

I. Objective

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8. Place paper down onto the inked surface of the block.
9. Hold carefully with one hand and burnish with a burnisher or the bowl of a spoon.
10. Pull print away and repeat.
11. Clean block by wiping with rag soaked with mineral spirits.

Student Activity #1

BASIC LINOLEUM BLOCK PRINTING PROCEDURES

I. Objective

You will take a prepared design and a linoleum block and basic printing equipment and complete the following tasks: Transfer a design, cut and print a black and white or one color print.

II. Materials

1. Linoleum Block
2. Knife
3. Gouges
4. Steel square
5. Tracing/carbon paper
6. Pencil
7. Paper to print on
8. Block printing ink
9. Brayer/hand press
10. Glass sheet
11. Minerals spirits
12. Burnisher
13. Spoon

III. Procedures

1. Tape a piece of transfer/carbon paper face down onto the linoleum block.
2. Tape the design face down on the carbon paper.
3. Trace all lines of drawing with a pencil.
   - A. The drawing will be in reverse.
   - B. After cutting and printing the block the print will appear as in the original design.

4. After tracing remove papers from block and black in all parts of the design not to be cut away.

5. Cut away all white areas leaving raised areas to print black.

6. Ink the brayer on the ink slab.

7. Roll a thin coating of ink over the raised surface of the block.

8. Place paper down onto the inked surface of the block.

9. Hold carefully with one hand and burnish with a burnisher or the bowl of a spoon.

10. Pull print away and repeat.

11. Clean block by wiping with rag soaked with mineral spirits.

Student Activity #2

ACETATE FILM ETCHING

Objective: You will take the materials provided and complete the following tasks: Etch an acetate film plate and print it.

Materials:
1. Acetate Film
2. pencil/paper
3. a scratch tool (compass, etc.)

Procedures:

1. Draw the master sketch in pencil on paper.
2. Tape a sheet of acetate over the sketch and scratch the lines on it with a sharp instrument.
3. Squeeze block printing ink onto a tile, wood board, or cardboard and roll it down evenly. Then press down a dauber made of cheesecloth or gauze to pick up the color. This is now daubed onto the scratched plate and excess wiped away with a clean rag.
4. Put the acetate plate on a cushion of newsprint. Place a sheet of printing paper on top of this. Weigh it with a book and stand on it to print, or run it through a press.

Student Activity #3

Objective: You will take the materials, as indicated and complete the following tasks:

Materials:

1. 1/4" thick Masonite linolem plastic or cardboard
2. black wrinkle finish spray paint (industrial finish)
3. print makers, hot plate, or heat lamp
4. white chalk for tracing
5. white lacquer (brushing type) acrylics or enamels
6. lacquer thinner
7. soft brush
8. stiff etching ink or black ink
9. cotton rags
10. thick etching paper
11. etching press or washer wringer type
12. blotter paper

Procedures:

1. Cut Masonite or plate material to size and bevel edges
2. Spray with black wrinkle finish paint. Spray second coat two minutes after first coat is dry.
3. Heat plate evenly on hot plate or with heat lamp. Do not overheat and bubble the paint.
4. Let plate dry thoroughly (overnight if possible), until mushiness goes away.
5. Chalk up the back of a tracing of design and trace white line onto black wrinkle finish.
6. Build up white paint in varying thicknesses as you develope the design on the plate.

7. Heat the plate and wet it or cover it completely with ink.
8. Wipe ink away with cloth.
9. Dampen paper and place between blotters.
10. Heat plate slightly to soften ink. Place dampened paper on plate.
11. Run through press under pressure.

SUGGESTED TEST

Block Printing

1. List the three methods of block printing.

   a.

   b.

   c.

2. List some of the early uses of block prints.

3. Printing may be divided into two divisions:

   a.

   b.

4. Define:

   Battleship linoleum______________________________

   V-Gouge______________________________________

   U-Gouge______________________________________

   Brayer_______________________________________

ANSWER SHEET

Suggested Test

1. a. Wood cut

   b. Linoleum

   c. Wood engraving

2. greeting cards, book covers, calendars, playing cards, pages of books murals

3. a. prints as a work of art

   b. all kinds of commercial prints

4. Battleship linoleum - linoleum used for block printing

   V-Gouge - Tool used for cutting wood cut or lino design

4. U-Gouge - Tool used for gouging wood cut or lino design

   Brayer - Hardrooler used to transfer the ink from inking slab to block.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

RUBBER STAMP CONSTRUCTION

DESCRIPTION OF UNIT

This unit will cover the principles involved in the construction of the rubber stamp plate and will list the usages of the plate. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will discuss the construction of the rubber stamp plate. He will be able to trace the origin of the rubber stamp plate and be able to list some of the common usages of the rubber stamp plate. Construct rubber stamp plate.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Discuss principles involved in construction of the rubber stamp plate.

2. List common usages of rubber stamp plate.

3. Identify terms related to the principles involved in the construction of the rubber stamp plate.

4. Demonstrate the ability to:

    1. Cut linoleum block mold
    2. Make clay stamp
    3. Press stamp in a mold
    4. Ink up stamp
    5. Print stamp

OUTLINE OF CONTENT

I. What is Rubber Stamp Printing? Information Sheet #

- A. A relief printing process; also known as flexographic printing.
- B. Materials needed for construction of Rubber Stamp Plate
    1. type / photo-engraving
    2. matrix mold
    3. rubber stamp gum
    4. mounting base
    5. rubber stamp press T.M. #
- C. Basic construction
    1. plastic matrices are made from the type forms.
    2. rubber plates are then made in the plastic molds by a special vulcanizing process in which heat and pressure are applied to the rubber stock.
    3. rubber plates are mounted on various kinds of bases or directly on press cylinders, with double faced tape.

II. Origin of Rubber Stamp Printing

- A. Letter Press Printing Information Sheet #
- B. Types used in letter press T.M. #
- C. Three types of presses used in letter press T.M. #

II. Construction of Rubber Stamp Plate Teacher Demonstration #
Student Activity #

- A. Teacher will demonstrate T.M. #
- B. Student will construct rubber stamp plate

IV. Common uses of rubber stamp

- A. milk containers
- B. gummed tape
- C. bread and candy wrappers

D. paperback books

E. foil bags

F. wall paper

G. office stamps

   1. date

   2. name

TEACHER ACTIVITI[illegible]

I. Provide student with student module.

II. Make transparencies.

III. Discuss unit and performance objectives.

IV. Review information sheet.

V. Give demonstration

VI. Give Test

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheet.

III. Make Rubber Stamp (office type)

Clay Simulation (Student Activity)

IV. Take test

REFERENCES/RESOURCES

I. Reference:

A. Carlsen, Darvey E, Tryon, Vernon A, Communication: Graphic Arts, Modular Exploration of Technology Series, Prentice-Hall, Inc., Englewod Cliffs, New Jersey.

II. Resources:

A. Information Sheets

B. Transparency Masters

Information Sheet #1

LETTERPRESS PRINTING

Letterpress printing is accomplished by means of type, of uniform height, assembled into groups, and locked up in a steel frame, or chase, for the printing press. Ink is applied to the faces of the types, and they in turn are pressed onto sheets of paper on which they leave their impression. The letters on types are cast in reverse, and the printing surfaces, or faces, of the letters stand out in bold relief above the type body.

There are different kinds of type, and their characteristics are determined by their differing methods of composition (the setting of type.) There is (1) hand type (2) type cast on slugs, (3) monotype composition, (4) woodtype (5) brass type, which is used exclusively by bookbinders.

Information Sheet #2

FLEXOGRAPHIC PRINTING

Rubber Stamp Printing

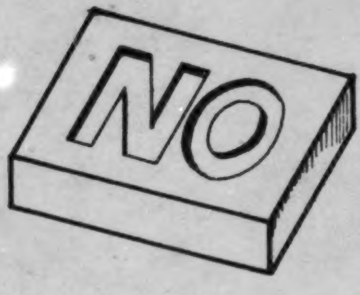
Flexographic printing, an extension from letterpress, is done with special ink and rubber plates, and is used in the printing of bags, wrappings, containers, and many different surfaces, such as burlap, glass, metal, or plastic.

Flexography printing is used largely by converters and package printers. Many flexographic presses operate as units of elaborate package manufacturing machines.

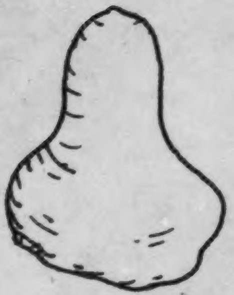
For small repeat design such as labels or candy wrappers, and for wall paper, decorative wrappings, and many kinds of roll printing, design rollers are used. These are rubber-covered cylinders on which a pattern of repeated or continuous design covers the entire circumference.

Rubber plates are used in special flexographic presses and for printing on hard or irregular surfaces difficult to print upon with type forms or metal plates. Plastic matrices are made from the type forms, and the rubber plates then are made in the plastic mkolds by a special vulcanizing process in which heat and pressure are applied to the rubber stock. Rubber plates may be mounted on various kinds of bases or directly on press cylinders, with double faced tape.

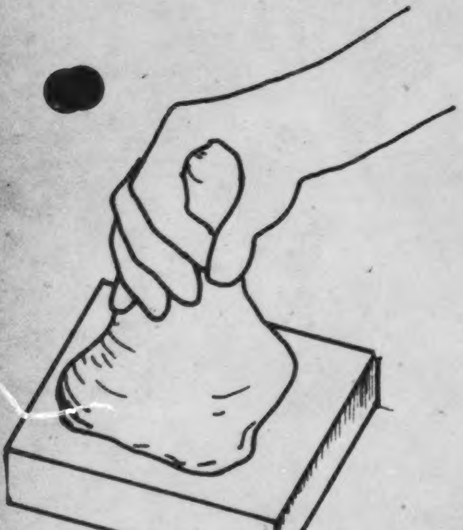
There are rubber stamp presses available that will enable you to produce quality rubber stamps without investing in a high priced machine. Some will make rubber plates for standing forms within the capacity of the chase.



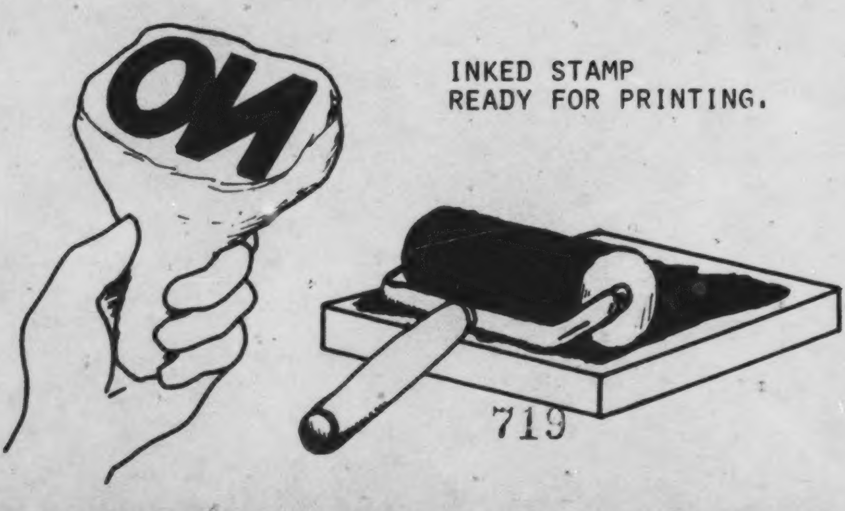
LINOLEUM BLOCK
ACTS AS MATRICE
OR MOLD WITH COPY
CUT BENEATH THE
SURFACE.



FIRM BUT MALLEABLE
CLAY (PLASTIZINE TYPE)
SHAPED TO FORM STAMP.

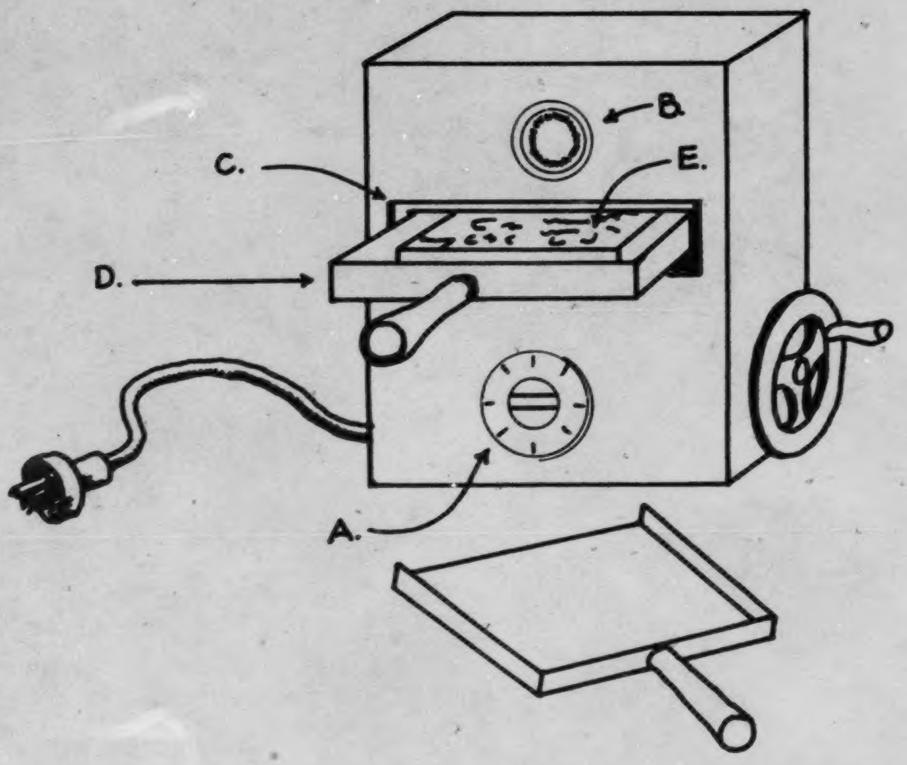


PRESS CLAY IN MOLD
FOR IMAGE TRANSFER.



INKED STAMP
READY FOR PRINTING.

RUBBER STAMP PRESS



A. THERMOSTAT TIMER

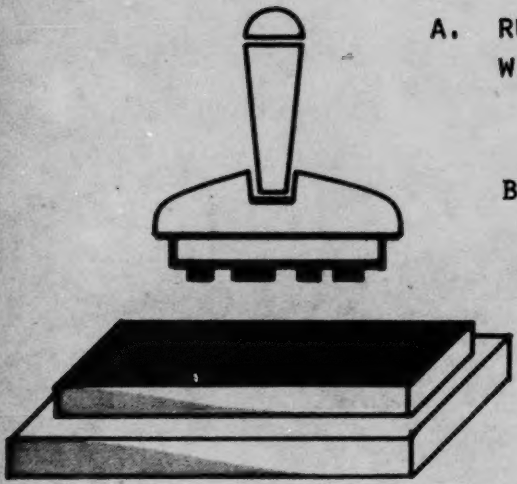
B. TEMPERATURE GAUGE

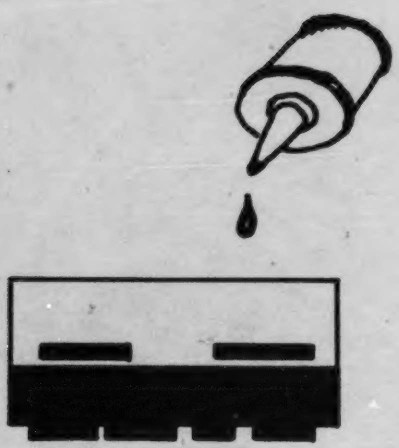
C. CHASE

D. VULCANIZING TRAY

E. MOULDING RUBBER

A. RUBBER STAMP
WITH INK PAD.


BASE
LETTERS


BASE
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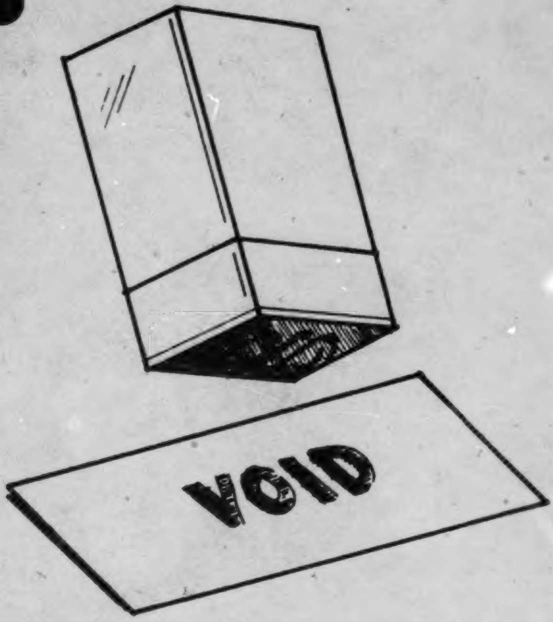


B. REFILLABLE STAMP
WITH A SOFT PLASTIC
BASE MATERIAL. THE
INK IS FILTERED
THROUGH TINY PORES
OR OPENINGS, TO THE
LETTERS. IT REQUIRES
NO PAD.

Student Activity #1

SIMULATED RUBBER STAMP CONSTRUCTION

Objective: You will take the materials given and correctly complete the following task: simulate rubber stamp construction.

Materials:

1. linoleum block
2. modeling clay
3. ink/inking pad, glass or plastic
4. roller or dauber
5. cutting tools
6. paper

Procedures:

1. Transfer or draw original design on linoleum block
2. Cut or engrave design in linoleum
3. make clay stamp to design specifications
4. press soft clay stamp into engraved linoleum black to get impression in relief
5. ink design on stamp with brayer or dauber
6. stamp or print

SUGGESTED TEST

Rubber Stamp Construction

1. A rubber cast of a die or slug is called a ____________________.

2. What term is used to describe relief printing from a rubber plate?

3. List some common uses for the rubber stamp.

4. Describe the vulcanizing process.

ANSWER SHEET

Suggested Test

1. Stereotype

2. Flexography

3. print on plastic films, foil bags, milk containers, gummed tape, bread and candy wrappers

TENNESSEE INDUSTRIAL ARTS CURRICULUM

Instructional Section:

GRAPHIC ARTS

Title of Unit:

HOT STAMPING

DESCRIPTION OF UNIT

This unit will cover basic hot stamping/gold stamping concepts. It will give an overview of the following areas: basic equipment, variables that control quality of printing, advantages and disadvantages of hot stamping, items printed by hot stamp method, printing procedures, career opportunities. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to identify hot stamping basic equipment, define the three variables that control quality of printing, list advantages and disadvantages of hot stamp printing, list items that are commonly printed by the hot stamp process. The student will demonstrate the ability to hot stamp print and discuss career opportunities.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Identify and describe basic hot stamping equipment.
2. Define terms and definitions.
3. List the 3 variables that control the quality of printing.
4. List 3 advantages and 1 disadvantage of hot stamp printing.
5. List items commonly printed by the hot stamp printing process.

6. Demonstrate the ability to:
    - A. Hot stamp print
    - B. Discuss career opportunities
7. Compare Hot Stamp Printing to Letterpress Printing

OUTLINE OF CONTENT

I. What is Hot Stamp Printing

A relief printing process; also known as gold stamping.

A. Three basic elements

Type, foil and item to be printed

B. General printing procedures

Type is placed in chase or head of printing press; heat is applied to the metal type and it is pressed down onto the item with a specially prepared foil between the type and the item being printed. The heat and pressure to the raised portion of the type causes the foil to release from the carrier and adhere to the item being printed. The pressure and the amount of time pressure is applied "dwell time" will cause the imprint to be slightly indented into the item.

C. An extention of Letterpress

II. Basic Equipment

A. Press (Transparency #1--Parts of the printing press)

1. Hand operated press

The press should have at least two or more different heat settings; pressure and dwell time are controlled by the operator.

2. Air-operated press

The press should have at least two or more different heat settings. Pressure and dwell time are set controlled and will operate at the same pressure and dwell time until controls are reset. An automatic foil feed is necessary for speed; the foil advances automatically each time you make an impression.

B. Jig (Transparency #1--Jig)

The jig keeps the item from moving while being printed. Each piece is registered in exactly the same way and supported underneath, if necessary, to take the pressure of the press. Commercial jigs are available for some items e.g., pens, pencils, satin award ribbons, matchbooks, etc.

C. Types (Transparencies #2, 3, 4--Type)

1. Hand type

Also known as printers type--each letter cast into its own, individual piece of lead to be placed onto the composing stick, by hand, for printing.

2. Linotype machine/Ludlow machine (slugs)

These two types of machinery, a lino type machine and a Ludlow machine will set a line of type on a single piece of lead. The lines are called "slugs", and are used in the manufacture of rubber stamps and in letterpress printing. The linotype machine is operated like a typewriter; when the operator punches the keys, molds are composed to form a letter. The Ludlow machine requires hand set molds. Both hand type and slugs are limited to lettering.

3. Photo-engraved zinc/magnesium dies

Art work--photo type
Photo-engraved zinc/magnesium dies permit any black and white artwork to be hot stamp printed by etching the artwork onto a plate or die and mounting finished product "type high". Additionally, the photo engraved zinc or magnesium die will outlast either form of type (hand or slugs) and can be obtained from a photo engraver.

4. Word Spacing (Transparency #5)

Spacing between the words is accomplished by inserting pieces of metal which are lower than the type itself. Being lower they do not come in contact with the paper and do not print. These pieces are called "quads" and are related in size to the "em quad", which is the square of the type size. For eg., if the type is 60 points, the em quad is a square 60 points by 60 points.

5. Leading (Transparency #5)

In addition to the space between the words, it is also possible to vary the space between the lines. To accomplish this, metal strips of various thickness are placed between the lines of type. This is called leading and the leads are measured in points. Their function is merely to separate the lines of type. They are less than "type-high" and do not print.

D. Foil

A type of foil with specially prepared backings designed to adhere to the many different materials hot stamp printed. Comes in colors, gloss, flat or metallic finishes.

E. Item to be printed

Most materials can be hot stamp printed e.g., paper, cardboard, leather, suede, vinyl, plastics, etc.

III. Variables that Control Quality of Printing

A. Heat/temperature

Varies with materials being printed, and foil used; usually between 225 and 250 degrees.

B. Pressure/dwell time

Def: Pressure: weight applied to the raised portion of the type and pressed down on the item to be printed; imprint will be slightly indented.
Using manual equipment--pressure controlled by operator.
Using air operated machine--pressure controlled by operator setting automatic controls.
Def: dwell time: amount of time pressure is applied to obtain clear impression.
Using manual equipment--dwell time is controlled by operator.
Using air operated equipment--dwell time controlled by the setting of automatic controls.

IV. Advantages and Disadvantages

A. Advantages

1. Requires no dryer

2. Economical to print--can print many different names on many different times.

3. Good for short runs

4. Multi-color printing practical

5. While hand set type is demanding it is good for turning out work in a hurry.

B. Disadvantages

1. Slugs break down very fast, virtually useless on hard items and for long runs.

2. With slugs on softer items a run of no more than a few hundred items can be printed while maintaining quality.

V. Items commonly printed by hot stamping process

  A. Logos on wallets

  B. Initials on luggage

  C. Pencils and pens

  D. Satin award ribbons

  E. Napkins

  F. Matchbooks

  G. Etc.

VI. Hot stamp printing procedures (Student Activity #1)

VII. Career Opportunities

  A. Compositor--hand, machine

    1. Sets type by hand or machine and assembles products of composing machine into pages.

    2. Distributes type back into cases.

    3. Makes corrections as indicated by proofreader.

  B. Proofreader

    1. Checks galley and page proof to see if they match copy furnished by customer.

    2. Checks spelling of all words and word divisions.

    3. Corrects obvious errors in grammar.

  C. Engraver

    1. Take line drawing or pictures and prepares an original letterpress printing plate.

    2. Mounts plate and prepares it for press.

  D. Equipment maintenance

    1. Has charge of maintaining and repairing all shop machinery

    2. Orders parts needed for repairs

E. Lock up man

1. Locks up forms for various kinds of letter press printing presses.

2. Imposes forms so that pages print in correct order.

F. Pressman

1. Prepares press for printing.

2. Runs job on press.

3. Cleans press after finishing.

TEACHER ACTIVITIES

I. Provide student with student module.

II. Make transparencies.

III. Discuss outline of content and specific objectives and information sheets.

IV. Discuss transparencies as they relate to outline of content explaining terms and giving demonstrations as you go.

V. Discuss student activity sheet.

VI. Demonstrate equipment to students stressing safety measures where applicable.

VII. Complete student activity.

VIII. Discuss career opportunities.

IX. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Complete activity sheet.

IV. Discuss career opportunities in related fields.

V. Take test.

REFERENCES/RESOURCES

I. References and Resources

A. Craig, James, Designing with Type: A Basic Course in Typography, Watson-Gupsill Publications/New York, 1977.

B. Screen Printing Magazine. Wasserman, Paul, So You Want to Get Into Hot Stamping?, Screen Printing Magazine, September, 1978, Vol 68/No. 9, pg. 46.

C. Miller Rex, Communication: Industry and Careers, Modular Exploration of Technology Series, Prentice Hall International, Inc., London, 1976.

D. Carlsen, Darvey, E., and Tryon, Vernon, A., Communication: Graphic Arts, Modular Exploration of Technology Series, Prentice Hall International, Inc., London, 1976.

II. Resources

A. Information Sheet

B. Transparency Masters

C. Student Activity Sheets

Information Sheet #1

Hot type: Refers to solid metal letter press type and letter press relief plates. The term "hot type" generally refers to the melting and casting procedures which occur to make the type.

LETTERING	ARTWORK - PHOTO
Hand set type in composing stick	Magnesium or zinc engravers etched dies
Machine set type or slugs linotype machine Ludlow machine	Die is mounted to "type High".918 to match printers type or slugs

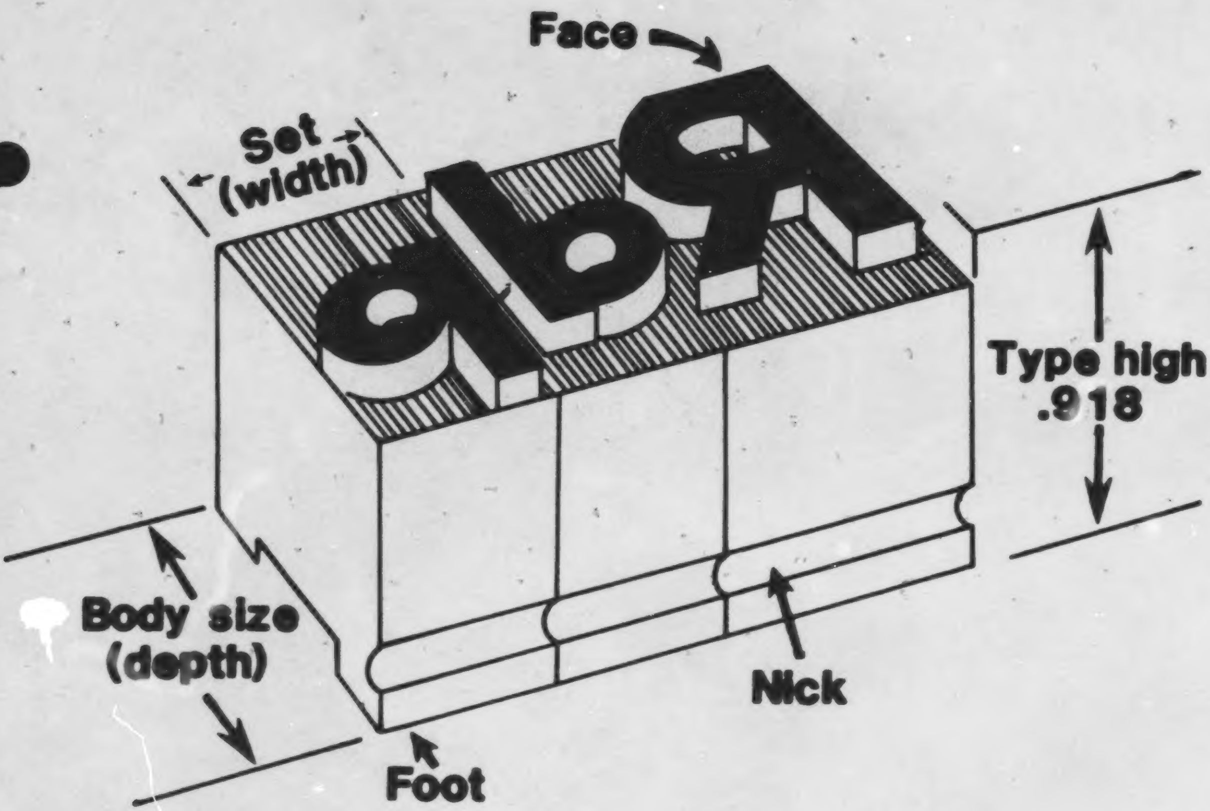
Handset type and slugs are limited to lettering only. The photo engraved zinc or magnesium die is much more versatile and will outlast either form of type.

The principle of platemaking in hot stamp printing is the same as in letterpress. The application of heat and pressure to the chase in hot stamp printing is the major difference.

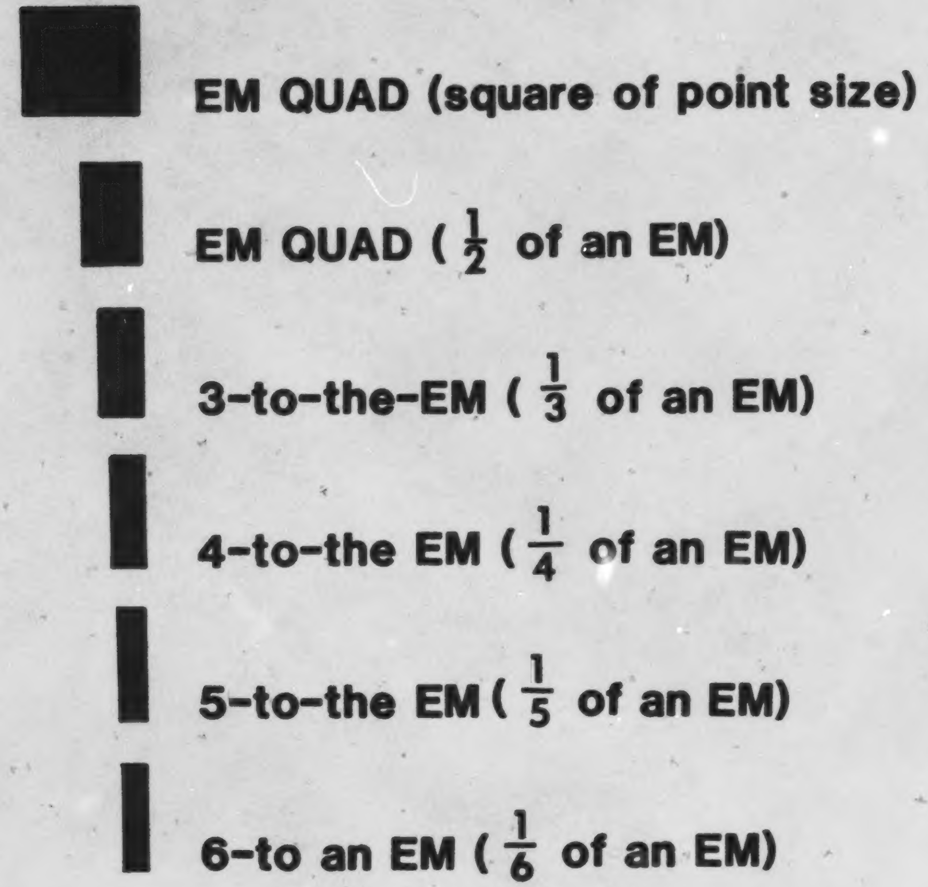
A PIECE OF TYPE

A piece of type is a rectangular block of metal with a printing surface on top. The block is called the "body" and the printing surface is called the "face".

The height of the body is .918" and is known as "type-high". Although this dimension is not important to the designer, it is very important to the printer that all type be exactly the same height in order to print evenly and consistently.


Face
Set (width)
Type high .918
Body size (depth)
Nick
Foot

EM QUAD AND ITS SUBDIVISIONS
WORD DIVISIONS



EM QUAD (square of point size)

EM QUAD ($\frac{1}{2}$ of an EM)

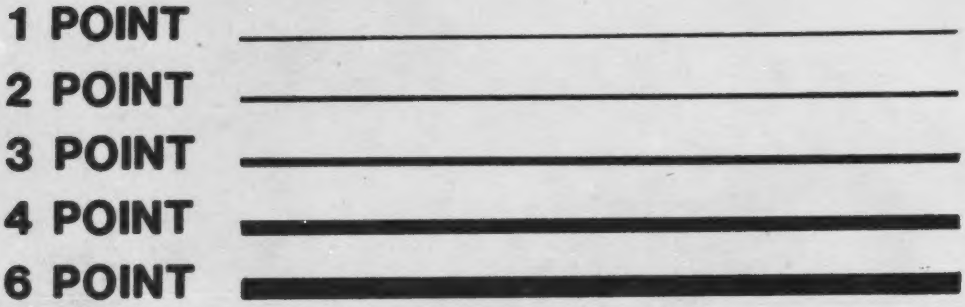
3-to-the-EM ($\frac{1}{3}$ of an EM)

4-to-the EM ($\frac{1}{4}$ of an EM)

5-to-the EM ($\frac{1}{5}$ of an EM)

6-to an EM ($\frac{1}{6}$ of an EM)

VARIOUS LEADS FOR CREATING SPACE BETWEEN LINES OF TYPE



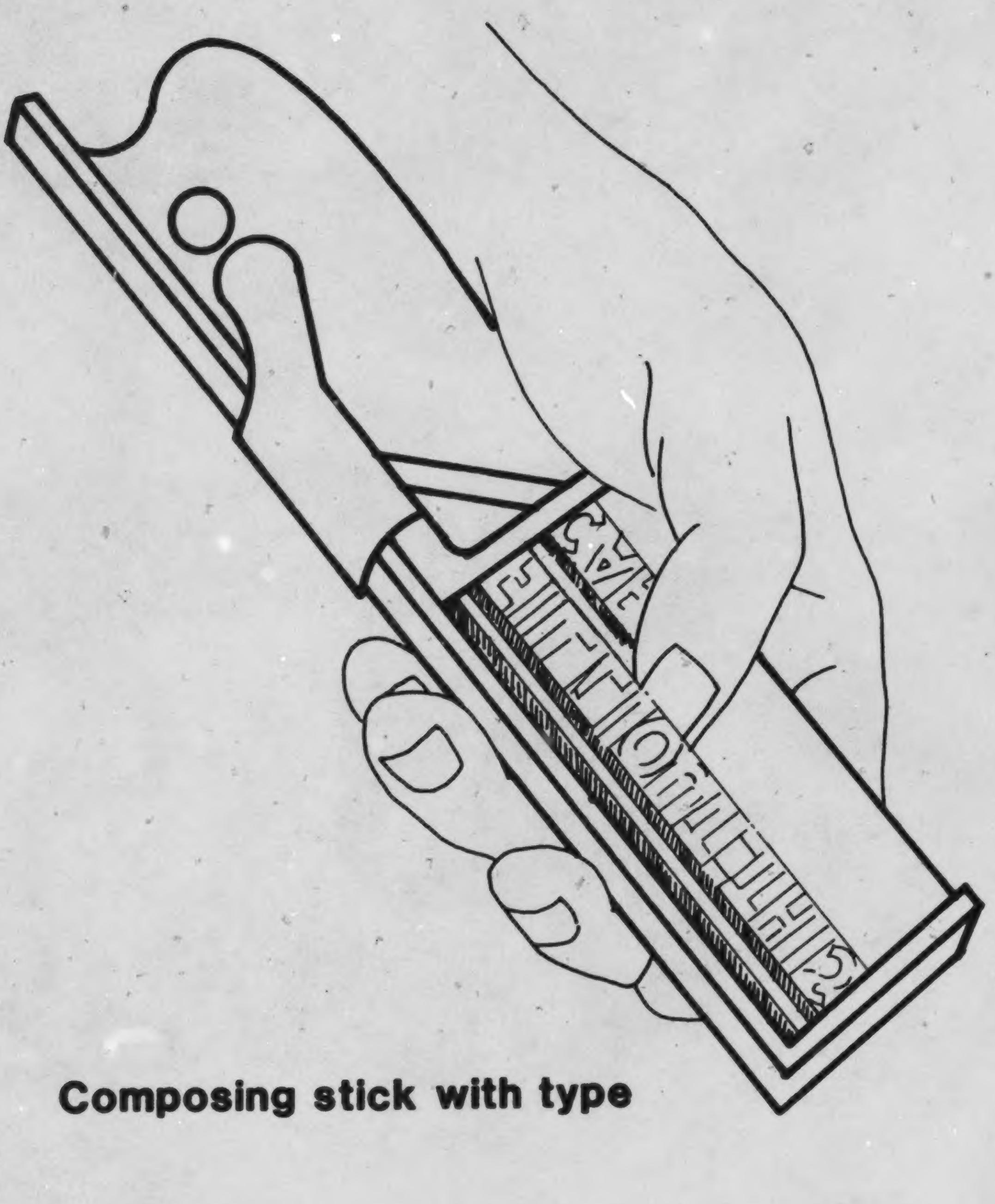
1 POINT

2 POINT

3 POINT

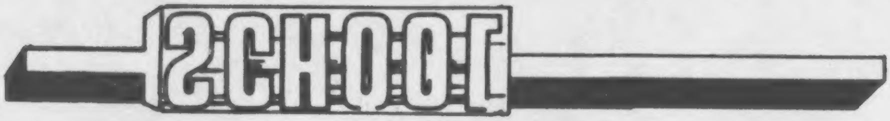
4 POINT

6 POINT

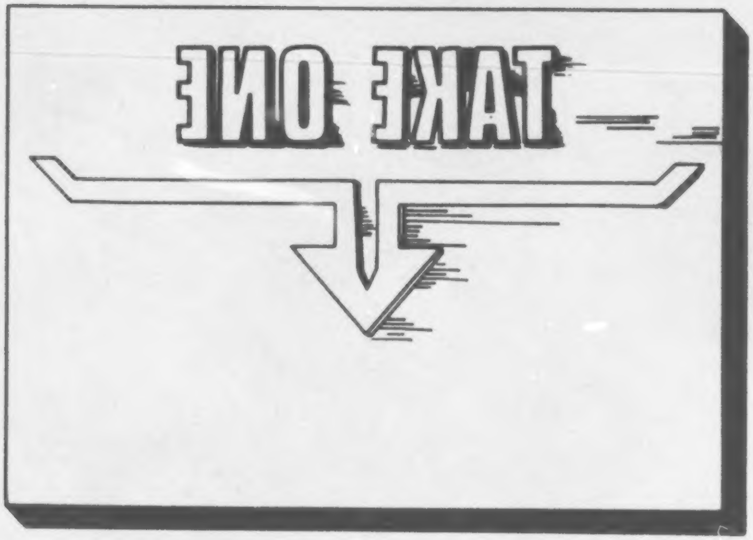


Composing stick with type

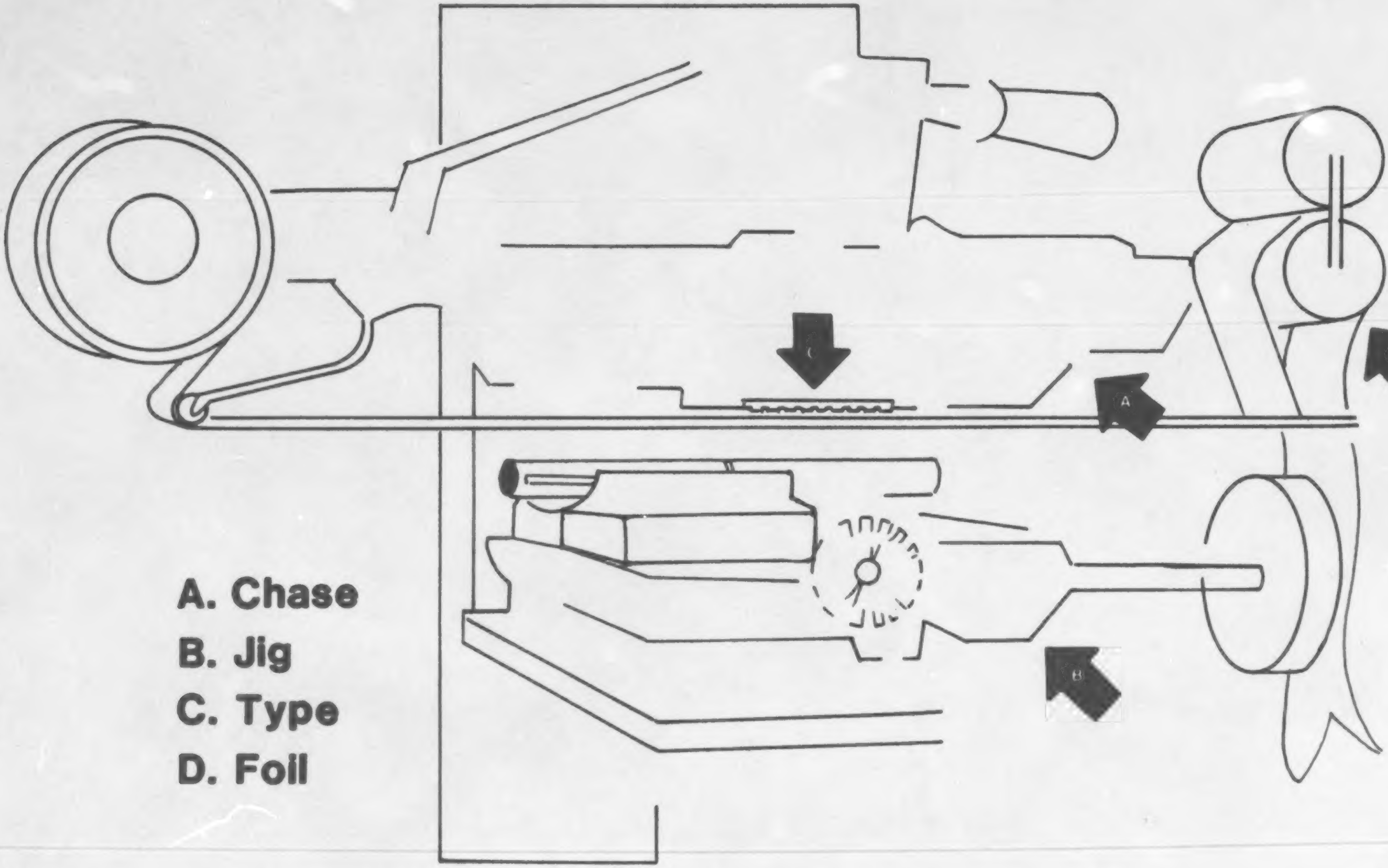
1. Ludlow slug



2. Magnesium die



BASIC PARTS OF A HOT STAMPING PRESS



A. Chase
B. Jig
C. Type
D. Foil

Student Activity #1

HOT STAMPING PROCEDURES

I. Objective:

You will take the materials given and correctly complete the following tasks:

1. Set a line of type
2. Print line of type
3. Clean type and return all equipment to the proper storage area

II. Materials

1. Press
2. Type/composing stick
3. Foil
4. Item to be printed
5. Galley
6. Leads and word-spacing
7. String/galley locks

III. Procedures

1. With a composing stick and type case set a line of type by inserting type into the composing stick. Make sure all nicks on the type are towards the open end of the composing stick.
2. When type has been set, transfer it to a galley (shallow three sided tray) and place the desired space between the lines.
3. Tie up type form with string or galley locks.
4. Lock type into printing head (chase) of press; allow press to heat to predetermined printing temperature.
5. Place foil between type and jig.
6. Secure item to be printed in jig.
7. Have your instructor ok your operation and watch you operate the press.

8. Press type on item being printed.
9. Make corrections if necessary e.g., dwell time, set up, temperature.
10. When run is completed, clean type and return type and other equipment to the proper storage place.

SUGGESTED TEST

Introduction to Hot Stamping/Gold Stamping

1. Define hot type.

2. Hot stamp printing is also called ____________________________.

3. List basic equipment used in hot stamping.

4. List the two kinds of type and explain their differences.

5. Define:

   a. Dwell time ____

   b. Leading ____

   c. Foil ____

   d. Slug ____

6. The printing surface of a piece of type is called the _______________

ANSWER SHEET

Suggested Test

1. "Hot type" generally refers to the melting and casting procedures which occur to make the type.

2. Gold stamping.

3. Press, type-composing stick, foil, item to be printed, galley, leads, galley locks

4. Hand type--set by hand
   Linotype machine--type set by machine

5. Define:

   a. Dwell time: the amount of time pressure is applied to the stock that is being gold stamped is called dwell time.

   b. Leading: metal strips of various thicknesses placed between the lines of type.

   c. Foil: foil prepared with a special backing designed to adhere to the many different materials hot stamp printed.

   d. Slug: a line of type set on a single piece of lead.

6. The printing surface of a piece of type is called the ______________

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

LITHOGRAPHY/OFFSET PRINTING
(Planographic process)

DESCRIPTION OF UNIT

This unit will cover the principles of lithography. It will give an overview of the following areas: a brief history of printing, the principles of lithography, the principles of offset printing, preparation of copy, typesetting, operation of offset press and career opportunities in the printing industry. The materials in this unit are designed for 10 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to: describe the principles of lithography and offset printing, prepare copy for printing, discuss career opportunities in the printing industry.

PERFORMANCE OBJECTIVE

After completion of this unit the student will be able to:

1. Understand terms and definitions.
2. Explain the principles of offset printing.
3. Discuss career opportunities.
4. Demonstrate the ability to:
   a. prepare copy
   b. set type for copy
   c. print plate

OUTLINE OF CONTENT

I. History of Printing--(See Information Sheet #1)

II. Principles of Lithography

A. Lithographic process--A photo-mechanical process which prints from photographically prepared plates. There are no raised printing surfaces standing in relief above a lower non-printing background. Lithography is a planographic or surface printing process.

B. Plates--The image or design to be printed is placed upon the surface of the plate by transfer, by photo-mechanical process or by being drawn directly on it. The surface is chemically treated so that the areas designed to print will resist water but will receive the lithographic inks. The remainder of the surface which is dampened between each impression, will remain entirely uninked, and will make no print on the paper.

1. Direct Image Plate--This plate is characterized by the fact that the image to be printed is lettered, drawn, typed, etc., onto the plate surface itself by using special pens, pencils, ribbons, etc. This plate is made of paper with a special chemically treated surface. Because the image is put directly onto the surface of the plate, this plate does not need to be exposed or developed. (See Information Sheet #3) (Demo #1)

2. Indirect Image Plate--This plate is characterized by the fact that the image to be printed is put onto a layout sheet and is transferred electrostatically or photographically to the plate. This requires the plate to be both exposed and developed. These plates are made of various materials, including paper, plastic, aluminum, and zinc.

III. Principles of Offset

A. The Offset Process--When ready to print the prepared plate is fastened around the plate cylinder of the lithographic press. After the metal plate is secured in the press it comes into contact with two sets of rollers. One set applies water which moistens all the surface expect the area especially prepared for printing, while the other inks these areas, but leaves no ink on the moistened surface. As the plate cylinder turns it comes into contact with the blanket cylinder which is a metal cylinder covered by a rubber blanket. The ink is transferred from the inked areas of the plate to the blanket in reverse. As paper moves through the press it is forced between the blanket cylinder and the impression cylinder. The impression cylinder forces the paper against the blanket and the ink is 'offset' onto the paper.

B. Offset Presses--Offset presses come in many different types, styles and sizes. The two major types are sheet presses and and web presses.

1. Sheet presses--Although these presses come in various sizes and styles, they are all characterized by the fact that paper is fed through the press one sheet at a time. Sheet presses are used to print when the final product is a printed single sheet.

2. Web presses—these presses also come in a variety of sizes and styles and they are characterized by the fact that paper is fed through the press in one long continuous sheet ('web'). Web presses are used to print such things as newspapers, magazines, many catalogs, many books, and decorative wrapping papers.

C. Other types of presses

1. Flatbed--A press where the printing stone or surface rests on a "flattened" type of table.

2. Cylinder--Presses equipped with automatic dampening and inking rollers and a cylinder for carrying the paper.

3. Rotary--Consists of two cylinders that rotate in the same direction. A plate on one cylinder and paper on the other. Trans #4

D. Operating the Offset Press. (See Information Sheet #4)

III. Copy

A. Copy--Typed matter, pen drawings, ruled work and copy with no shading or graduation of tones are line copy.

B. Screen--Photographs, wash drawings, and all matter in varying density of tones are screen copy and they must be photographed through a half tone screen, This changed them into a pattern of dots, and makes them line copy.

C. Copy for Offset--The preparation of the plates in offset printing is essentially a photographic process, the treatment of the copy differs widely from the building of the type form for use in the letterpress. The copy is placed before the camera, a negative is developed, and the image is then transferred to the printing plate. When some units of the

D. Masking Sheet/line up table--In order to arrange and position negatives together in a predetermined form, in a manner in which the image may be transferred to a printing plate, the films are mounted on a masking sheet, on a glass-topped light of line-up table, which is equipped with precision instruments for squaring, spacing, and aligning the copy. No alteration can be made in positioning or spacing after the plate is made.

IV. Typesetting--The lettering which is photographically applied to offset printing plates is produced by several means: 1) much of it is set in metal type in letterpress composition plants which supply reproduction proofs for offset copy. Single display lines, masses of body type or completely made-up pages of matter are assembled for offset. 2) other methods known as cold composition are in use. Cold composition does not involve use of metal type. Most of the matter is produced or assembled by one of the general classes of type setting devices listed:

Photo typesetting or photo-composition machines; machines producing photographic strip lettering or film or paper for heading and display lines. Typewriting machines which set body matter, paper alphabets and clip book for which characters may be cut put and assembled as copy. Student Activity #1

V. Careers in Printing Industry

A. Printing Occupations
B. Machine Maintenance
C. Skilled Occupations
D. training Requirements

(Information Sheet #6.)

TEACHER ACTIVITIES

1. Provide student with student module.
2. Make transparencies.
3. Discuss unit and specific objectives.
4. Discuss information sheets and go through outline of content, giving demonstrations as you go.
5. Discuss student activity sheets. Give demonstrations for student activity sheets #1 and #2.
6. Evaluate student activities.
7. Plan field trip to a newspaper or large printing company.

STUDENT ACTIVITIES

1. Read objective sheet.
2. Study information sheets.
3. Complete activity sheets.
4. Take test.
5. Take field trip (suggested).

REFERENCES/RESOURCES

References:

1. Carlsen, Darvy E., Graphic Arts, Peoria, Ill.; Chas. A. Bennett Co., Inc., 1970.

2. Carlsen and Tryon, Communication: Graphic Arts, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1976.

3. Cogoli, John E., Photo-Offset Fundamentals, Bloomington, Ill., McKnight and McKnight Publishing Co., 1973.

4. Naval Education and Training Command, Rate Training Manual, NACEDTRA 10452-C, United States Government Printing Office, Washington, D.C., 1975.

5. Polk, Ralph W., The practice of Printing, Charles A. Bennett Co. Inc., Peoria, IL, 1964.

Resources:

1. Information Sheets
2. Transparency Masters
3. Activity Sheets
4. Demonstrations

Information Sheet #1

HISTORY OF PRINTING

If we were to divide the last 50,000 years of man's existence into lifetimes of approximately sixty-two years each, there would have been about 800 such lifetimes. Of these 800 lifetimes, 650 were spent in caves. Only during the last seventy lifetimes have we been able to communicate effectively from one lifetime to another with writing. Just think of the stories that Columbus could have written; the Bible could have been written first-hand. The American West and the Indians, cavemen, someone before. We could know many things for being true if there had been written proof. However, only during the last six lifetimes has man seen the printed word. For the last four lifetimes we've been able to measure time with some precision, and only in the last two has anyone, anywhere used an electric motor. It is evident how much progress man has made after the invention of the printed word. Realize that most of the material goods that we use each day have been accumulating since man began to store up useful printed knowledge. The rate took an "upward" leap with the invention of writing. It took another leap in the 15th century when Gutenberg invented movable type. At that time it became possible to produce some 1000 books a year. By 1950 books were produced at a rate of 120,000 per year. By 1960 this went to 1000 books per day. Today the rate accelerates by the minute, giving us immeasurable resources for knowledge.

This very recent and vast accumulation of knowledge led to new duplicating processes which in turn led to new discoveries that are now replacing old familiar processes. There are some inventions already available which are not being used due to cost and the fact that we are not ready to advance so rapidly. We are at the point now where knowledge is doubling about every four years, an almost overwhelming thought for teacher and students to face because it means continual change in subject content and increases still more our dependence on printing--what we now call Graphic Communications.

Today, paper is used for a diverse number of products--books, maps, drawings, magazines, forms, bulletins, reports and others that would take a book to list.

To give the student an idea of the importance and increase in printing, take your students to your library and tell them how long it would have taken to print all of the books before movable type. For instance, before Gutenberg an ordinary person could not buy a book. After Gutenberg, approximately 1000 books a year could be printed.

GA 5.9

Information Sheet #2

Chronology of Printing

Scribes (10-20 books a year)	1423
Movable type, Gutenberg	1453
Aniline dye, Shapiro could be used to duplicate handwriting	1880
Carbon paper Stencils - Edison	1880
Electric motor - Edison	
First typewriter, Sholes	1867
Linotype	1884
Stone Lithography, Alois Senefelder	1796
Photography	1839
Zinc plates	1860
Offset press, Ira Rubel	1906

Information Sheet #3

Direct Image Plates

One of the simplest plates that can be used on the press is the direct image offset plate. This plate has advantages over some of the other types of plates. Basically, the plate is designed for short run prints--some say the maximum number of impressions is from 1000 to 5000. However, as any plate, the number of impressions that can be used or printed by the plate is greatly dependent upon the condition of the printing press and the experience of the operator.

Copy is put on the direct image plate by:

1. Typewriter--A carbon ribbon produces the best type for copy and produces more impressions.
2. A direct image pencil or pen. The pen or pencil can be used for drawings, handwritten copy or as an aid in layout. A non-reproducing pencil is to be used for laying out copy, since it does not print on the master.

An advantage of this plate is that it is probably the least expensive of any offset plate. It requires no developing, solutions or special care. It is subject to fingerprints, hand lotions, grease, etc.--something that the typist must be aware of. It should be handled by the edges, such as film is handled.

An offset printing job can be done with an offset press and the direct image plate. Although limited in the number of impressions, it can be preserved and saved.

A disadvantage of the plate is that is can be easily ruined, if not used as directed. It cannot be cleaned satisfactorily once it is on the press. Erasures can be made when typing or preparing the plate with a soft rubber eraser.

Operation of the Offset Press

Operation of the offset press involves the successful setup and adjustment of the basic systems of the press. Specific techniques for individual presses differ; assistance may be required from the manufacturer or operational manuals.

The general process is as follows:

1. Load paper and set up paper feed system.
2. Adjust paper registration system.
3. Adjust paper delivery system.
4. Adjust fountain system.
5. Adjust inking system.
6. Install image carrier (the plate) on plate cylinder.
7. Turn on main power switch.
8. Engage inking and fountain form rollers.
9. Contact plate to blanket cylinder.
10. Turn on paper feed mechanism.
11. Make necessary image position changes.
12. Maintain adjustments of all systems as job is printed.
13. Clean the press.

Information Sheet #5

Cleaning the Offset Press

Objective:

To demonstrate clean-up proceudres for the offset press in order to have the machine ready for use the next day.

Procedure:

1. Remove the printing plate. (Preserve the plate if it is to be used again.)
2. Remove fountain solution.
3. Check condition of dampening rollers. Clean or replace, if necessary.
4. Remove and wash the ink fountain.
5. Use cleaner sheets to clean all ink rollers.
6. Remove and clean all ink rollers that can be removed.
7. Reassemble all parts removed in the clean-up procedures.
8. Clean the frame of the offset press.
9. Secure the night latch on the machine.

PROCESSING

In this context "Processing" means the conversion of artwork, photograph and type reproduction into a form in which they can be printed.

Though the printing medium may differ - letterpress, photolithography, photogravure, silk-screen - the processing of any but the simplest elements for these must involve the use of photography at some stages. Thus, there are certain factors common to all print media processing. For example, since orthochromatic film material is commonly used, but is not sensitive to process cameras and may be used for instruction marks and construction lines which are not intended to be reproduced. Again, where full colour reproduction is required, any of the media processes will involve the use of colour filters to separate the image photographically in blue, red, yellow and black plates which will overprint to give a full colour result. So it can be seen that preparation of material for processing does not differ greatly between one medium and the other.

Conditions to establish at the outset are:

a) If the medium is letterpress, is the type to print the metal direct or from a plate made from a type impression?

b) If the medium is photolithography, photo-gravure or silk-screen, must the material for processing be submitted with all elements reduced to the same scale or can the required reduction merely be indicated on overlays?

Apart from establishing the above conditions, the preparation of work for processing is similar whatever the medium. The word "plate" when used in this context is taken to refer to the physical product of the letterpress, litho or gravure processing techniques, and even, by extention, to the silk screen process (though of course in this case the product us a screen and not a plate).

Information Sheet #7

CAREERS IN PRINTING INDUSTRY

Almost every town in the country has a print shop. Some of them are weekly newspapers which take on other printing jobs to keep the presses running. More than one-half of the people employed in printing are located in five states: New York, Illinois, California, Pennsylvania, and Ohio. Most of the printing plants are located near cities that have large populations. These are places such as New York City, Chicago, Los Angeles, Philadelphia, San Francisco-Oakland, Cincinnati, and Cleveland. Book and magazine printing are highly concentrated in these areas. There are some other large employment areas for printers.

PRINTING OCCUPATIONS

Production of printer materials involves workers in a wide variety of jobs. Printing skilled workers numbered about 400,000 in 1970. They represent a large portion of the printing occupations. They usually specialize in one area of printing operations (for instance, type setting, photography, platemaking, presswork, or binding.) Their training, moreover, is confined largely to only one of the basic printing methods - letterpress, lithography, or gravure.

The largest group of skilled workers are the composing room workers. There were about 185,000 of them in 1970. This group includes hand compositors, type-setting machine operators, make-up people, tape-perforating machine operators.

Other large groups of skilled workers are printing press workers and their assistants, lithographic skilled workers, including camera operators, artists, strippers, platemakers, and lithographic pressworkers. Some of the other important printing skilled workers are bookbinders, photoengravers, electrotypers, and stereotypers.

MACHINE MAINTENANCE

A number of different trades are employed in the maintaining of machines that produce copy and actually do printing. For instance, maintenance machinists repair and adjust typesetting machines, printing presses, or bindery equipment. They are usually found working in large plants. In most of the smaller plants the owner may hire someone to do the work whenever it is needed.

SKILLED OCCUPATIONS

Most of the skilled occupations use men. Practically all these occupations are filled by men. However, many of the less skilled jobs, especially in the binderies are filled by women. This is changing as women are becoming more skilled and interested in these high paying jobs.

Printing equipment used today is becoming complex and mechanized. Because of this, the need is growing for technically trained people in all areas of printing. An increasing number of production technicians are being employed throughout the printing industry. These people are responsible for seeing that the standards established for printing each job are met. Many of these people acquire experience working in small shops and then move on to larger companies.

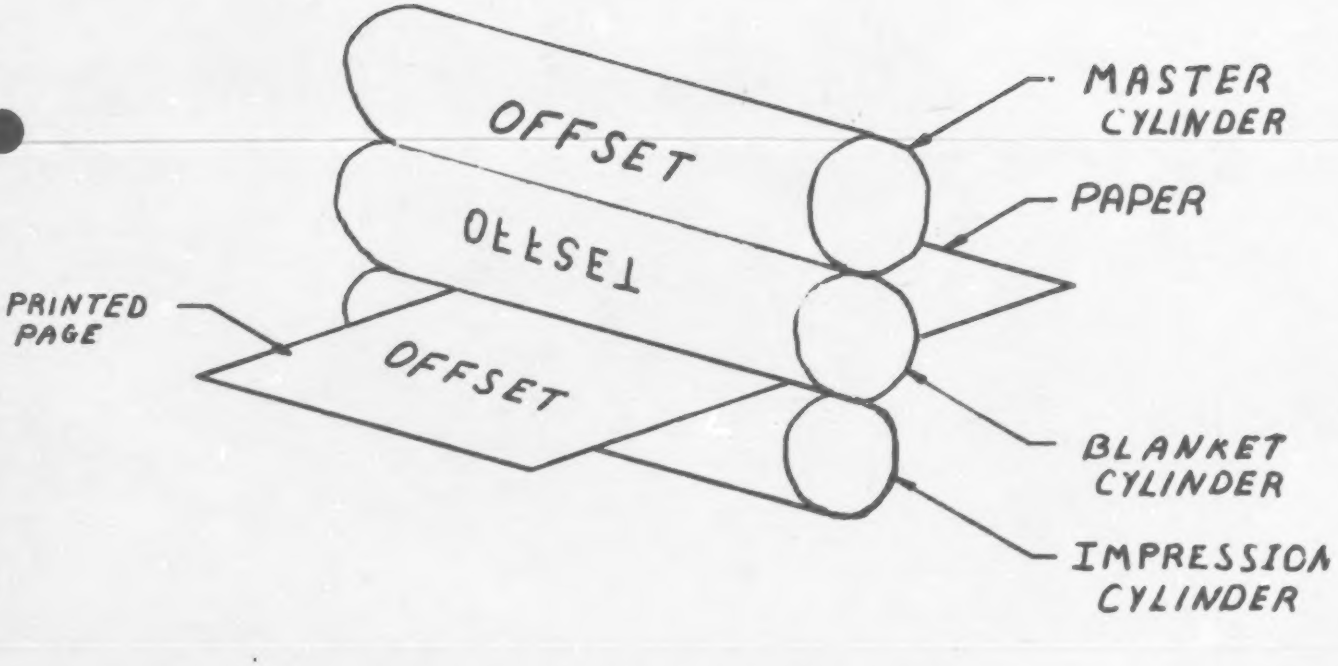
TRAINING

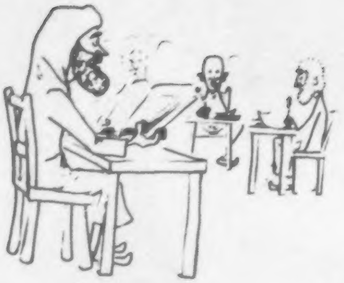
Apprenticeship is a common method of getting a start in the printing crafts. In some cases, it is the only means by which a person may be trained to become a journeyman* (skilled worker) in a unionized shop. A formal program of apprenticeship is required for journeyman status in many larger establishments that are not unionized.

In 1970 there were about 13,800 apprentices registered and in training in the skilled printing crafts. A registered apprentice is an employee, who, under an agreement, receives instruction in a specific occupation for a specified period time. The apprentice is registered with a state apprenticeship agency or the U. S. Dept. of Labor's Bureau of Apprenticeship and Training.

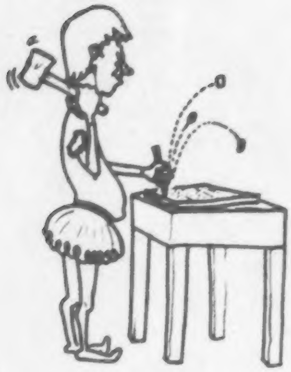
Apprenticeships for the printing trades usually last from 4 to 6 years. The program covers all sides of the particular trade. It generally includes classroom or correspondence study courses. The materials studied is directly related to the job being done at the time. As new printing methods are developed and introduced, they generally are included in the duties of the traditional printing crafts and in the apprenticeship program.

THE OFFSET PROCESS

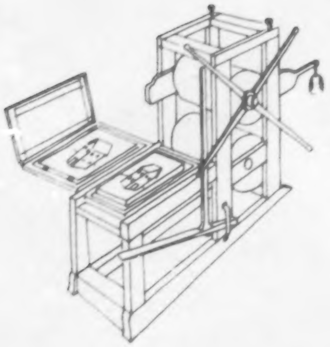

MASTER CYLINDER
PAPER
PRINTED PAGE
OFFSET
OFFSET
OFFSET
BLANKET CYLINDER
IMPRESSION CYLINDER



The Scribe

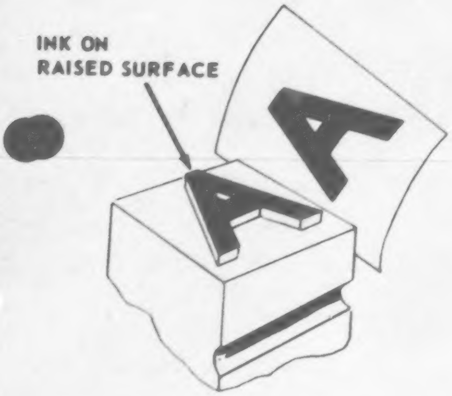


The Stone Printer

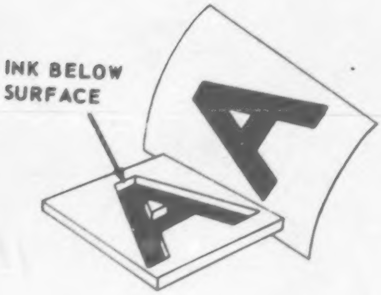


An Early Flatbed Press

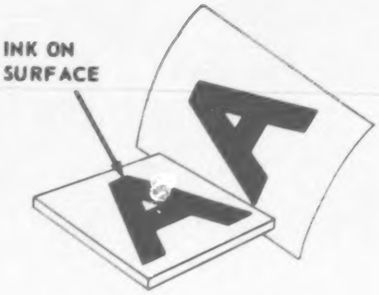
THREE METHODS OF PRINTING


INK ON
RAISED SURFACE

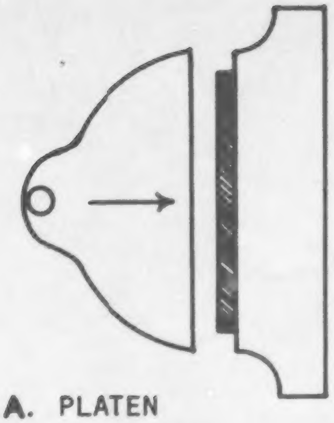
Letterpress


INK BELOW
SURFACE

Intaglio Process

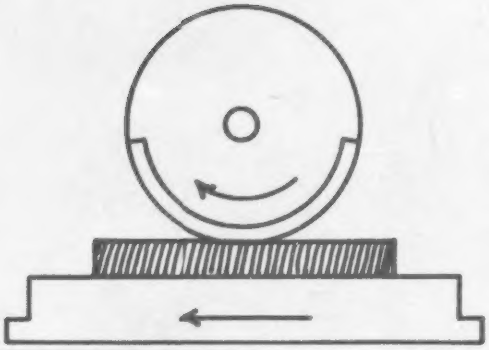

INK ON
SURFACE

Lithographic Process



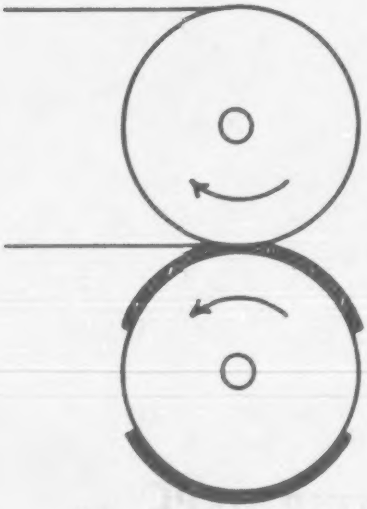
A. PLATEN

A. THE PLATEN PRESS HOLDS ITS TYPE FORM ON A FLAT BED. THE IMPACT OF A FLAT PLATEN MAKES THE IMPRESSION.



B. CYLINDER

B. CYLINDER PRESSES HOLD THEIR TYPE FORMS ON A LARGE FLAT BED, WHICH MOVES BENEATH AN IMPRESSION CYLINDER



C. ROTARY

C. ROTARY PRESSES ARE BUILT FOR HIGH SPEED WORK. THE IMPRESSION IS TAKEN BETWEEN TWO CYLINDERS WHICH ROLL TOGETHER.

Student Activity #1

Objective:

You will take a direct image offset plate and complete the following tasks:

1. Write your name on the plate with a reproducing pencil.
2. Sketch an object with a non-reproducing pencil. Go over the outline sketch with a reproducing pen.
3. Type a line across the master with a manual typewriter and a regular fabric ribbon.
4. Type the same line again using a typewriter with a carbon ribbon.
5. Have the teacher to use your plate to reproduce several copies.
6. Make notes on the result of each instrument you used on the plate after it has been printed.

Materials:

1. Direct image offset plate
2. Non-reproducing pencil
3. Reproducing pencil
4. Reproducing pen
5. Manual typewriter

SUGGESTED TEST

True or False

1. _____ _____ There are no raised printing surfaces in offset or lithographic printing.

2. _____ _____ In the offset process, the plate is dampened then inked on each revolution.

3. _____ _____ Line copy contains many gradation of tones.

4. _____ _____ Direct image plates are more expensive than most other offset plates.

5. _____ _____ Apprenticeship programs in the printing industry usually last 1-2 years.

1. List three types of presses.

   a.

   b.

   c.

2. List the five states that have most of the printing industry.

   a.

   b.

   c.

   d.

   e.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

SILK-SCREEN PRINTING

DESCRIPTION OF UNIT

This unit will cover silk-screen printing concepts. It will give an overview of the following areas: What is screen printing, basic printing equipment, the paper-stencil, the photo stencil, and major areas of specialization. The materials in this unit are designed for 15 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to define silk screen printing, identify the basic silk screen equipment, and discuss the major areas of specialization in silk screen printing. The student stencil as well as basic printing.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. Give a definition of silk screen printing.
2. Identify basic printing equipment.
3. Demonstrate the ability to:
    - A. Cut a paper stencil.
    - B. Print a paper stencil.
    - C. Prepare a photo stencil
    - D. Print a photo stencil

OUTLINE OF CONTENT

I. Silk Screen Printing--a stencil process in which ink is forced through a mesh of silk or other synthetic screen material onto the surface of the printing stock. The screen stencil may be prepared by hand or photographically.

II. Basic Equipment

   A. Screen frame--a rectangular hoop that keeps the fabric (screen) stretched tight for printing.

   B. Screen--Polyester, nylon, organdy, silk or tafetta fabric.

   C. Squeegee--the tool which forces the ink through the screen mesh onto the printing surface.

   D. Substrate--the product material in silk screen printing that is to have a design printed on it.

   E. Ink--the pigment (or coloring medium) that is forced through the screen onto the substrate.

III. Stencil Methods

   A. Hand--any method where the image is put on the stencil by hand. It involves covering the surface to be printed with an impervous material like paper or cardboard. Openings are cut into the material, revealing underlaying surface. Ink is passed across the stencil which acts to block out all but the open areas. When the stencil is removed only the shapes of the open areas are printed on the substrate. The two primary hand stencil methods are using paper and lacquer film.

   B. Photo Stencil--any method whereby the image is put upon the screen using a photographic process. It involves breaking up the image photographically into a dot pattern similar to a halftone photograph. The printing screen is coated with a sensitizing solution and the dot pattern is photographically transferred onto the screen. On the parts of the screen not to be printed the sensitizing solution is chemically hardened while the solution on the other parts of the screen is washed away leaving open areas on the screen. Ink can then be forced through the open areas on the screen onto the substrate.

      1. Direct

      2. Indirect

IV. Areas of Specialization

- A. Commercial sign printing
- B. Poster printing
- C. Wall paper
- D. Table cloths
- E. T-shirts

TEACHER ACTIVITIES

1. Provide student with student module.
2. Make transparencies.
3. Discuss unit and specific objectives.
4. Discuss information sheets and go through outline of content giving demonstrations as you go.
5. Discuss student activity sheets.
6. Give test.
7. Plan trip to silk screen printing plant.

STUDENT ACTIVITIES

1. Read objective sheet.
2. Study information sheets.
3. Complete activity sheets.
4. Take test.
5. Take trip to silk screen printing plant. (Suggested)

REFERENCES/RESOURCES

References:

Biegeleisen, J.I. Screen Printing, Watson-Gupsill Publications, New York Evans Bros Ltd., London, 1974.

Lassiter, Frances and Donna. Screen Printing, Contemporary Methods and Materials, Hunt Manufacturing Co.,1978.

CBIE Project, Kansas State Department of Education.

Resources:

1. Information Sheets
2. Transparency Masters
3. Activity Sheet
4. Demonstrations

Terms and Definitions

1. Base--A flat board or table top to which the screen frame is hinged. (Bed)
2. Ink--The pigment (or coloring medium) that is forced through the screen onto the substrate.
3. Intaglio--The design is scratched, engraved, or etched into the plate. These depressions are filled with ink. Etching and drypoints are examples. Gravure printing is the industrial equivalent.
4. Planographic (or surface)--Printing is done from a smooth surface treated chemically or mechanically so that some areas will print and other areas will not. Offset lithography is the only common example.
5. Pushpin hinge--A two part hinge held in an interlocking position by a fitted pin or rod. It's used to attach the screen to the print bed.
6. Register--The exact positioning of the design image on the printing surface, a matter of special importance in multicolor work.
7. Registration guides--Small tabs of cardboard, metal or other material fastened to the base against which the stock to be printed is registered in a predetermined position.
8. Relief printing--That in which the design stands above the general level of the plates surface. Rubber stamps and fingerprints, woodcuts, linoleum cut, letter press.
9. Run--A shop term referring to the actual printing procedure or the extent of an edition.
10. Screen frame--A rectangular hoop that keeps fabric stretched tight for printing.
11. Silk screen printing--A stencil process in which coloring matter is forced onto the material to be printed through the mesh of the silk or organdy screen so prepared as to have pervious printing areas and impervious non-printing area.
12. Squeegee--Used to force the screen printing ink through the open mesh.

13. Stencil printing--Is accomplished by cutting designs out of stencil paper or by making some portions of thin fabric impervious to liquids. Ink goes through the open portions but not through those that are impervious. Silk-screen printing is the best known type.

14. Stock--A broad connotation referring to paper, cardboard, glass, metal or whatever material is to be printed.

15. Substrate--The product material in silk screen printing that is to have a design printed on it.

Information Sheet #2

AREAS OF SPECIALIZATION

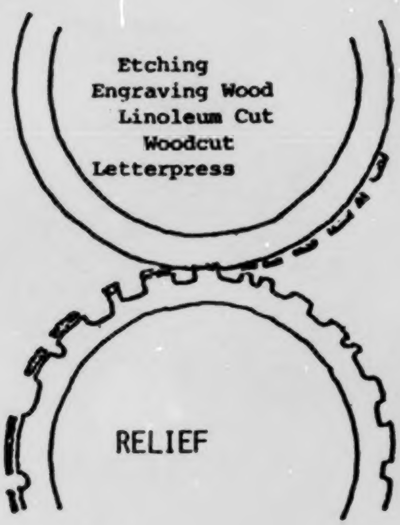
The production of commercial signs and posters constitute the backbone of the screen printing industry in terms of total number of people employed, output measured by annual dollar volume of business, and number of individual businesses.

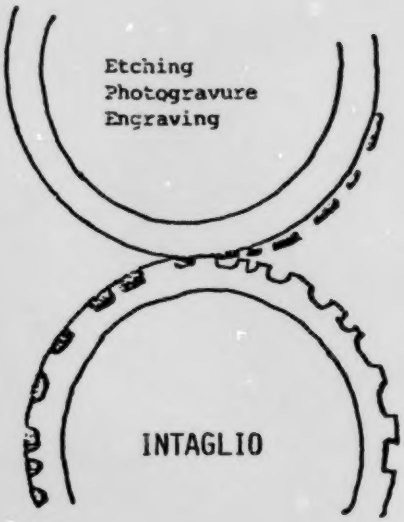
Screen printing on container ware has evolved into a distinct field of operation quite separate and apart from routine screen printing. The decorative motifs on drinking glasses have been printed by the screen process. Its the most economical and effective way to print colors on glass.

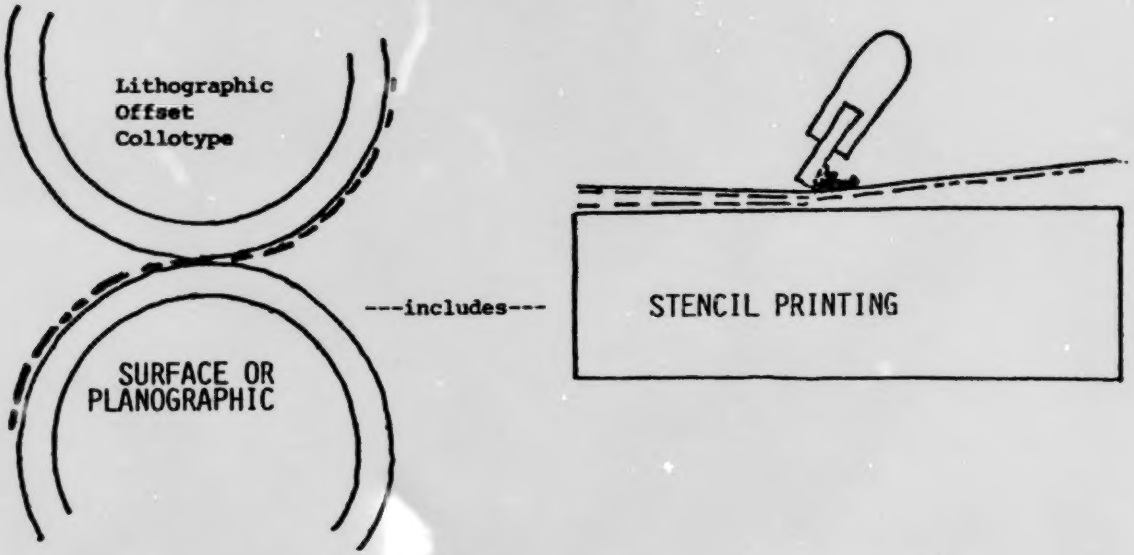
It is difficult to categorize the great diversity of fabrics and end products in the broad area of the textile decorating field that lend themselves to screen printing. Dress goods, toweling, drapery and upholstery material, tablecloths and napkins, cloths used for shirting, lounge and sleepwear and t-shirts represent a partial listing of products that can be screen printed.

Screen printing, with particular preference to wall paper has a number of advantages. It's possible to print a light color over a dark ground when the design calls for it. It's less expensive for short run editions. Stencils cost less to prepare than the printing plates used in gravure and other metods. Colors can be as bright as you want them to be.

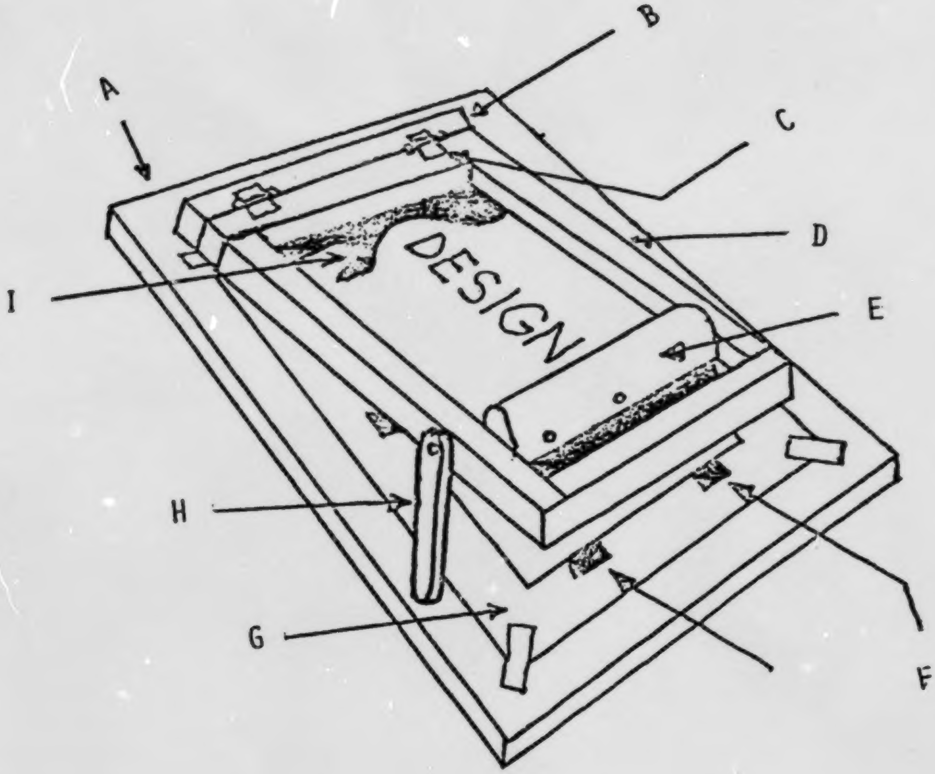
THREE BASIC METHODS OF REPRODUCTION


Etching
Engraving Wood
Linoleum Cut
Woodcut
Letterpress
RELIEF


Etching
Photogravure
Engraving
INTAGLIO


Lithographic
Offset
Collotype
SURFACE OR PLANOGRAPHIC
---includes---
STENCIL PRINTING

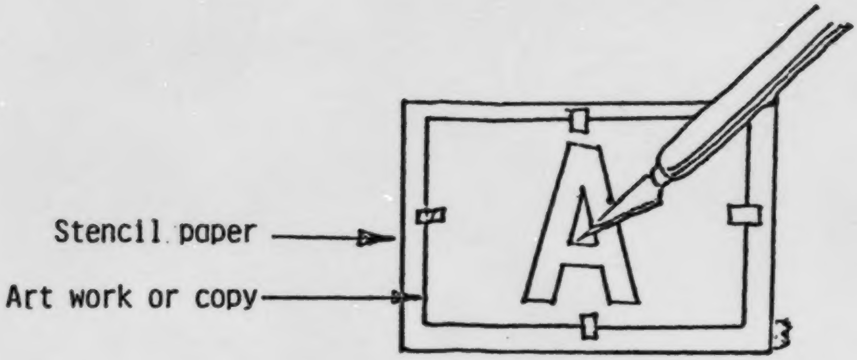
BASIC PRINTING EQUIPMENT

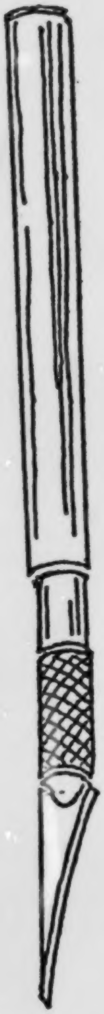


A - BASE- may be table top or any flat board
B - Hinge Bar
C - Loose Pin Hinges
D - Screen Frame
E - Squeegee
F - Guides - against which stock is placed when printing
G - Proof Sheet- attached to base with tape
H - Kick-leg or Prop-bar
I - Ink

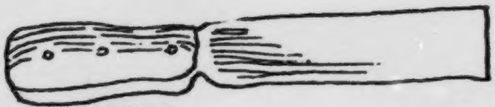
BASIC PRINTING EQUIPMENT

PAPER STENCIL

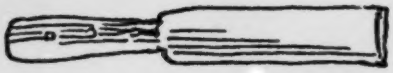

Stencil paper
Art work or copy
A



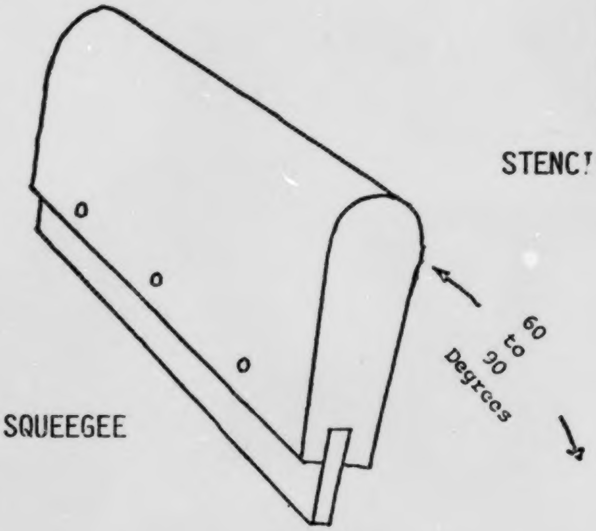
STENCIL KNIFE



SPATULLA



PUTTY KNIFE


60 to 90 Degrees

SQUEEGEE

Demonstration #1

PAPER STENCIL METHOD

Objective:

To show the process of designing, properly preparing and printing a paper stencil.

Materials:

1. Carpet tacks or staples, if staple gun is available
2. Clean, soft, lintless cloths
3. Markers or guides for registering printing
4. Masking tape or gummed paper tape
5. Mineral spirits, kerosene, or turpentine
6. Newspaper, butcher paper
7. Screen printing frame
8. Screen fabric
9. Screen printing ink
10. Squeegee
11. Stencil knife
12. Stock or material upon which to print
13. Transparent tracing paper

Procedures:

1. Cut a brown butcher paper stencil 1/2" or so larger than the inside dimension of the screen.
2. Place tracing of original art or design in place. Trace cut outlines of the art using a well sharpened knife.
3. Place stencil sheet under the screen and run a band of ink the length of the image and along the hinge side of the screen.
4. With a firm and even pressure, sueegee it from the center outward to both sides.

5. Pull the squeegee across the screen firmly. The angle between the squeegee and the screen should be between 60 to 90 degrees.

6. Replace the squeegee along the hinge side of the screen.

7. Remove the proof sheet or newspaper and insert the material to be printed.

8. After printing is completed, remove excess ink with cardboard or spatula for reuse.

9. Place newspaper between screen and base, pour small amount of solvent on screen, work into screen with soft cloth. Raise screen occasionally to work from both sides. Be sure all ink has been removed from the image area and frame.

GA 6.12

Demonstration #2

PHOTO STENCIL METHOD

Objective:

To show the process of preparing and printing a photo stencil.

Materials:

1. Light box
2. Screen
3. Emulsion
4. Cleaning solvent
5. Rags
6. Glue
7. India ink and tracing paper
8. Printing ink
9. Printing stock
10. Squeegee
11. Spatula
12. Masking tape
13. Newspaper
14. Pen or brush for preparing design

Procedure:

1. Prepare the design--design should be made on tracing paper or transparent surface. The sketch must be dark enough so that it blocks out any light source, for example, black crayon, on tracing paper, or India ink on tracing paper, a photo negative or positive.

2. Prepare photo sensitive emulsion--follow package instructions for mixing of sensitizer and emulsion. The preportion is usually 1 part of sensitizer to 4 parts emulsion. This process is to be done in a semi-dark area.

3. Apply emulsion to screen--in a dimly lit room hold screen at a slant and apply emulsion onto the screen. Spread emulsion across the scxreen using a straight-edged tool. Turn screen over and even out emulsion on backside. Repeat process once or twice. Remove excess emulsion and replace in jar for reuse.

4. Dry Screen--After emulsion is applied let screen dry, as quickly as possible in dimly lit room. A fan should be used to speed drying process, being careful that the screen and fan are in a fairly dust-free area.

5. Placement of design on exposing table--
   a. Clean top of light box if dirty
   b. Place design right side up on top of exposing unit (light box)
   c. Place screen on top of design

6. Expose sensitized screen—expose screen--time will differ according to light source.

7. Wash out--using a spray hose, wash screen until design appears in screen.

8. Block out holes, etc. with glue or excess emulsion.

9. Register position of paper

10. Print

Student Activity #1

PAPER STENCIL METHOD

Objective:

You will take the materials given and correctly complete the following tasks: cut paper stencil to size, fasten art to stencil, cut stencil, adhere stencil to screen, print screen.

Materials:

1. Carpet tacks or staples, if staple gun is available
2. Clean, soft, lintless cloths
3. Markers or guides for registering printing
4. Masking tape or gummed paper tape
5. Mineral spirits, kerosene, or turpentine
6. Newspaper, butcher paper
7. Screen printing frame
8. Screen fabric
9. Screen printing ink
10. Squeegee
11. Stencil knife
12. Stock or material upon which to print
13. Transparent tracing paper

Procedures:

1. Cut a brown butcher paper stencil 1/2" or so larger than the inside dimension of the screen.
2. Place tracing of original art or design in place. Trace cut outlines of the art using a well sharpened knife.
3. Place stencil sheet under the screen and run a band of ink the length of the image and along the hinge side of the screen.
4. With a firm and even pressure, sueegee it from the center outward to both sides.

5. Pull the squeegee across the screen firmly. The angle between the squeegee and the screen should be between 60 to 90 degrees.
6. Replace the squeegee along the hinge side of the screen.
7. Remove the proof sheet or newspaper and insert the material to be printed.
8. After printing is completed, remove excess ink with cardboard or spatula for reuse.
9. Place newspaper between screen and base, pour small amount of solvent on screen, work into screen with soft cloth. Raise screen occasionally to work from both sides. Be sure all ink has been removed from the image area and frame.

GA 6.16

Student Activity #2

PHOTO STENCIL METHOD

Objective:

You will take the materials given and correctly complete the following tasks: design, properly prepare, and print a photo-stencil screen.

Materials:

1. Light box
2. Screen
3. Emulsion
4. Cleaning solvent
5. Rags
6. Glue
7. India ink and tracing paper
8. Printing ink
9. Printing stock
10. Squeegee
11. Spatula
12. Masking tape
13. Newspaper
14. Pen or brush for preparing design

Procedure:

1. Prepare the design--design should be made on tracing paper or transparent surface. The sketch must be dark enough so that it blocks out any light source, for example, black crayon, on tracing paper, or India ink on tracing paper, a photo negative or positive.

2. Prepare photo sensitive emulsion--follow package instructions for mixing of sensitizer and emulsion. The preportion is usually 1 part of sensitizer to 4 parts emulsion. This process is to be done in a semi-dark area.

3. Apply emulsion to screen--in a dimly lit room hold screen at a slant and apply emulsion onto the screen. Spread emulsion across the scxreen using a straight-edged tool. Turn screen over and even out emulsion on backside. Repeat process once or twice. Remove excess emulsion and replace in jar for reuse.

4. Dry Screen--After emulsion is applied let screen dry, as quickly as possible in dimly lit room. A fan should be used to speed drying process, being careful that the screen and fan are in a fairly dust-free area.

5. Placement of design on exposing table--
    a. Clean top of light box if dirty
    b. Place design right side up on top of exposing unit (light box)
    c. Place screen on top of design

6. Expose sensitized screen--expose screen--time will differ according to light source.

7. Wash out--using a spray hose, wash screen until design appears in screen.

8. Block out holes, etc. with glue or excess emulsion.

9. Register position of paper

10. Print

SUGGESTED TEST

1. Screen printing is a stenciling method originated in____________.

2. List two advantages of silk screen printing.

   a.

   b.

3. Give one disadvantage of silk screen printing.

   a.

ANSWERS TO SUGGESTED TEST

1. Asia

2. a. Good for short runs

   b. Can be printed on almost any surface

3. Not good for long runs.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

POSTERS

DESCRIPTION OF UNIT

This unit will cover the procedures in the development of a poster. It will identify parts of a poster and the function of those parts as they relate to one another. The materials in this unit are designed for 5 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to discuss the procedures in the development of a poster. He will demonstrate the ability to complete a thumbnail sketch, complete a rough drawing, and complete a comprehensive layout.

PERFORMANCE OBJECTIVES

After completion of this unit the student will be able to:

1. List procedures in the development of a poster.
2. Define the elements of design.
3. Define the principles of design.
4. Demonstrate the ability to:
    A. Complete a thumbnail sketch.
    B. Complete a rough drawing.
    C. Complete a comprehensive layout.
    D. Complete a comprehensive poster layout suitable for reproduction.

OUTLINE OF CONTENT

I. Steps Involved in Producing a Poster

   A. Thumbnail Sketch--Thumbnail sketches are used mainly to suggest the position of the different parts of the poster. By working broadly and at a small scale, many arrangements can be made quickly. (Teacher will demonstrate.)

   B. Rough Layout--Rough layout should be actual size and should give specifications for size and kinds of type required and their location. This is a guide for composing type. (Teacher will demonstrate.)

   C. Comprehensive Layout--Comprehensive layout is almost an exact copy of how the printed piece will appear after its completion. A comprehensive layout is frequently required for many jobs reproduced in industry. (Teacher will demonstrate.)

   D. Type Composition--Most modern type composition is done in one of the following two ways:

      1. Photo Composing Machine--Operated with a keyboard similar to a typewriter. Many kinds of photo composing machines are available. Some are very simple and inexpensive, while others are more complex and very expensive. Almost any style and size of type is available on modern photo composing machines. (TM #1)

      2. Pre-printed Alphabets--Available in a wide variety of sizes and styles of type. Transfer letters consisting of black images and transparent sheets are commonly used. When transferred to transparent acetate a transparent positive can be made which can be used in making photo screen stencils without making a positive photographically. (TM #2)

   E. Paste-Ups--A layout table or drawing board with "T" square and 1 triangle are helpful for making good paste ups. Guidelines are used to assist in properly locating the various parts of the image to be assembled and to keep each part square. Copy preparation layout and paste up for screen printing are the same as for offset reproduction.

   F. Printing the Poster--Most posters are reproduced by either screen printing or offset. The factors determining selection of the printing process includes design, size, thickness, of stock, and length of run. If the design includes a photograph or a long run (100 or more) offset is recommended. It is not practical to print 4-ply poster board on small offset presses.

II. Elements of Design (Information Sheet #2)

  A. Line

  B. Texture

  C. Value

  D. Space

  D. Color

  E. Hue

III. Principles of Design (Information Sheet #3)

  A. Unity

  B. Rhythm and Repetition

  C. Proportion

  D. Balance

TEACHER ACTIVITIES

I. Provide student with student module.

II. Discuss unit and performance objectives.

III. Review information sheets.

IV. Give demonstrations.

V. Give test.

STUDENT ACTIVITIES

I. Read objective sheet.

II. Study information sheets.

III. Take test.

Information Sheet #1

POSTERS

A poster should convey an idea in an instant. It should not be crowded with detail while conveying the important idea. The poster should sell the idea.

Composition is the form of the poster and arrangements of the parts. There should be 1 or more points of interest. The placement of these points of interest is very important.

A layout of the poster should be made to insure proper placement of the points of interest and the proper placement of the lettering. The layout should be done in silhouette. It should be enlarged and the spacing should be constantly checked when making the poster.

Lettering should be kept simple and planned carefully. Heavy letters should be used since they can be read at a greater distance. Lettering should be horizontal, never vertical. Top and bottom guide lines should be lightly drawn for all letters used.

The background should remain less vivid in contrast to the lettering or illustration shown against it. Color contrast should generally be strong.

Information Sheet #2

Elements of Design

1. Line--An important element of design and one that may create many different feelings is line. Lines may be short and heavy, or long and lean, straight and curved, dotted or dashed, or one of many others you may or may not have seen.

2. Texture--To give the viewer the idea of an object with a rough surface or to show the realistic surface of the object being drawn.

3. Value--Value deals with the lightness and/or darkness of a color. If you were to take what we call a pure color and add white it would be called a tint. If black were added, it would be called a shade. By adding either black or white, you will change the value of the original but it will not change the hue. This value change may also be accomplished using only the values of black and white to form grays.

4. Space--The area in a picture (two dimensional sufrace) or drawing that separates the items or objects. As objects advance (come forward) or recede (go back) in the picture, space is created. The use of value in color creates space.

4. Color--There are many different things about color you should know before you will understand its use.

5. Hue--Hue is the name of a color. It is the way we can recognize one color from another. An example would be a green leaf. Green is the hue, leaf is the object. Red wall, red is the hue, wall is the object.

6. Primary Colors--The primary colors for pigment (or paint) are: red, yellow, and blue. Mixed, these three colors will make about every hue (color),

7. Secondary Colors--The Secondary Colors are made when any two primary colors are mixed in equal quanities. The Secondary Colors are: red+blue=purple, blue+yellow=green, yellow+red=orange.

8. Teritary Colors--The mixing of a primary color with a secondary color, whatever the proportion, you get a tertiary color.

19. Complementary--Any two colors that are opposite each other or the color wheel. Complements, when mixed, tend to dull each other.

0. Monochromatic Color--The use of one color in varying tones and intensities.

Information Sheet #3

PRINCIPLES OF DESIGN

UNITY: Whether you use similar or different ojbects to complete your work, it is important that the whole arrangement be pulled together into one idea visually.

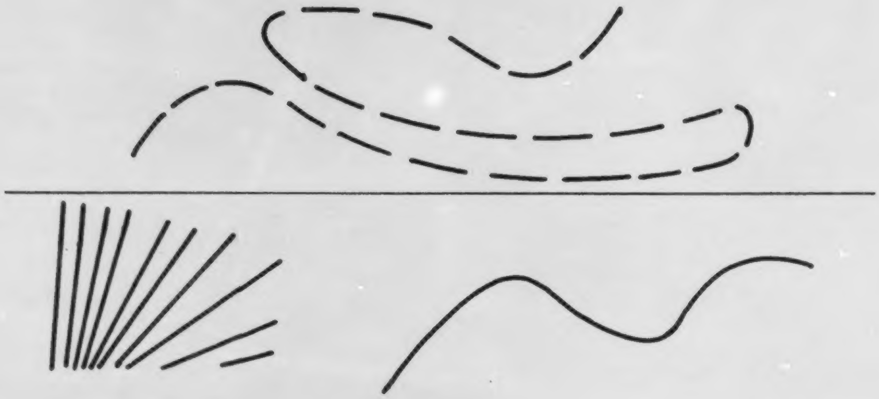
RHYTHM and REPETITION: If you vary the shape and/or size of the objects in your drawings, in orderly fashion, they will act in a rythmic movement also.

PROPORTION: To maintain interest and variety in your picture, proportion becomes very important. To do this you should divide the area of your picture into varying sizes.

BALANCE: An important principle of composition is balance. There are two forms of balance which you will most likely use in the graphic communications field: formal (or symmetric) and informal (or asymmetric.)

T.M. -1 [illegible] GA [illegible] 3-A

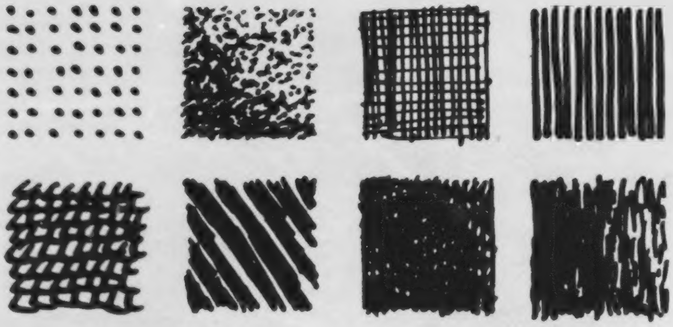
ELEMENTS OF DESIGN



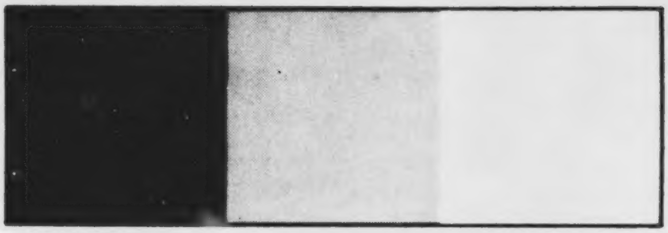
LINES MAY GIVE YOU THE FEELING OF MOVING FAST OR SLOW. THEY MIGHT BE STATIC OR DYNAMIC. LINES CREATE ENERGY AND DIRECTION.

TEXTURE:

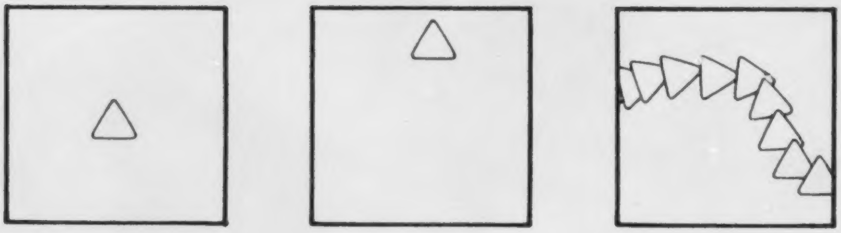
OBJECTS WITH A ROUGH SURFACE.



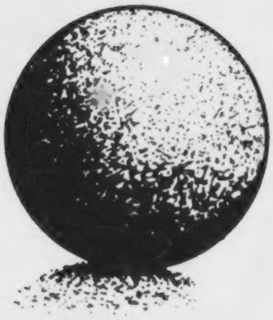
1. VALUE SCALE



VALUE CHANGES WILL HELP CREATE
DEPTH IN A PICTURE.

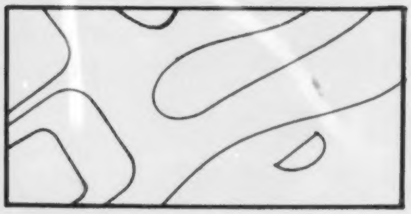


2. SPACE AS OBJECTS ADVANCE
AN RECEED.

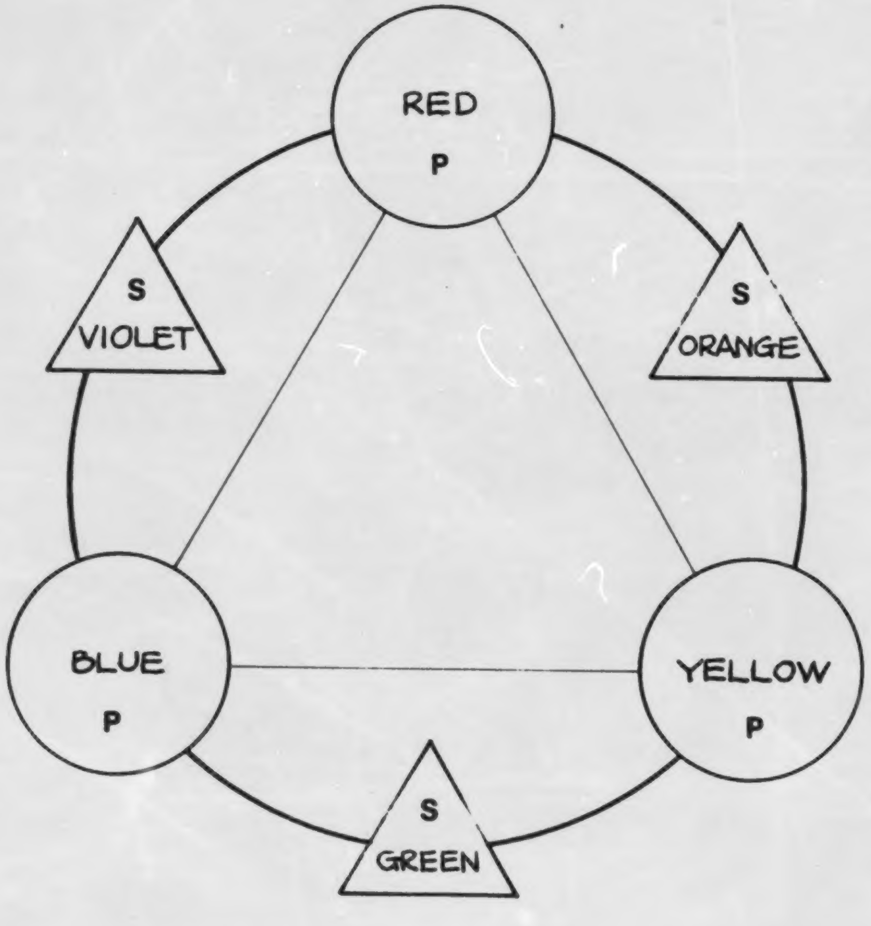


3. VOLUME, MASS
OR 3-DIMENSION

4. SHAPE AREA
OR 2-DIMENSION



5. COLOR WHEEL WITH PRIMARY & SECONDARY COLORS.

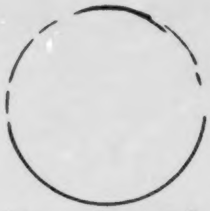

RED
P
S
VIOLET
S
ORANGE
BLUE
P
YELLOW
P
S
GREEN

SKETCHING

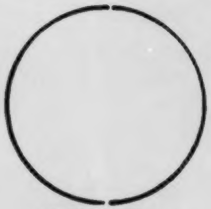
Straight (no stops)

Straight

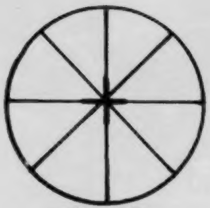
Done by drawing one section , moving hand to right, adjoining as close as possible gives the appearance of one line.



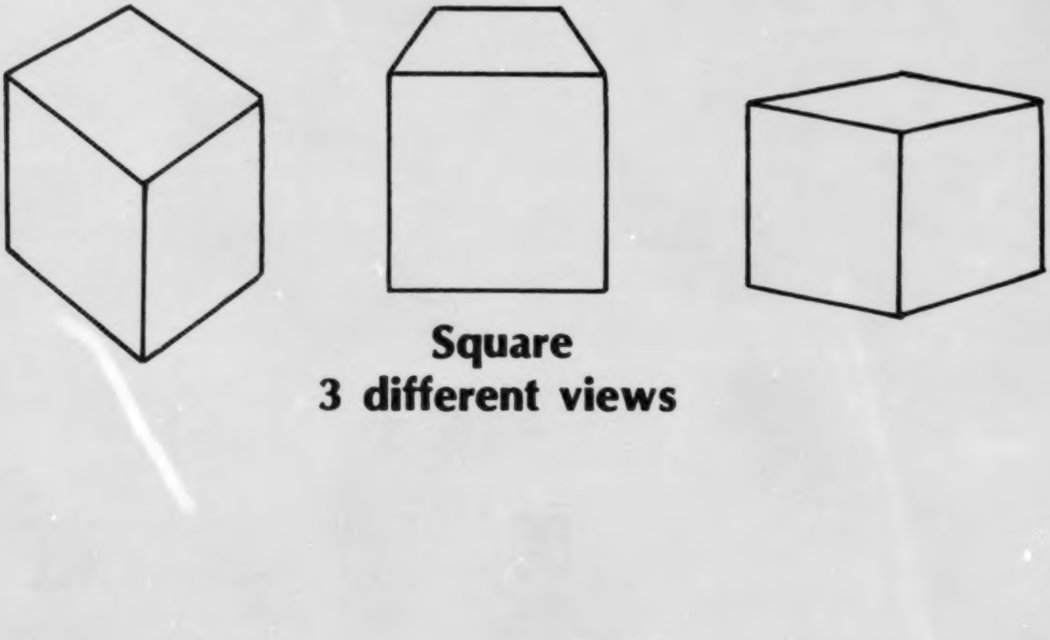
Freehand circle



Circle (2 arcs)

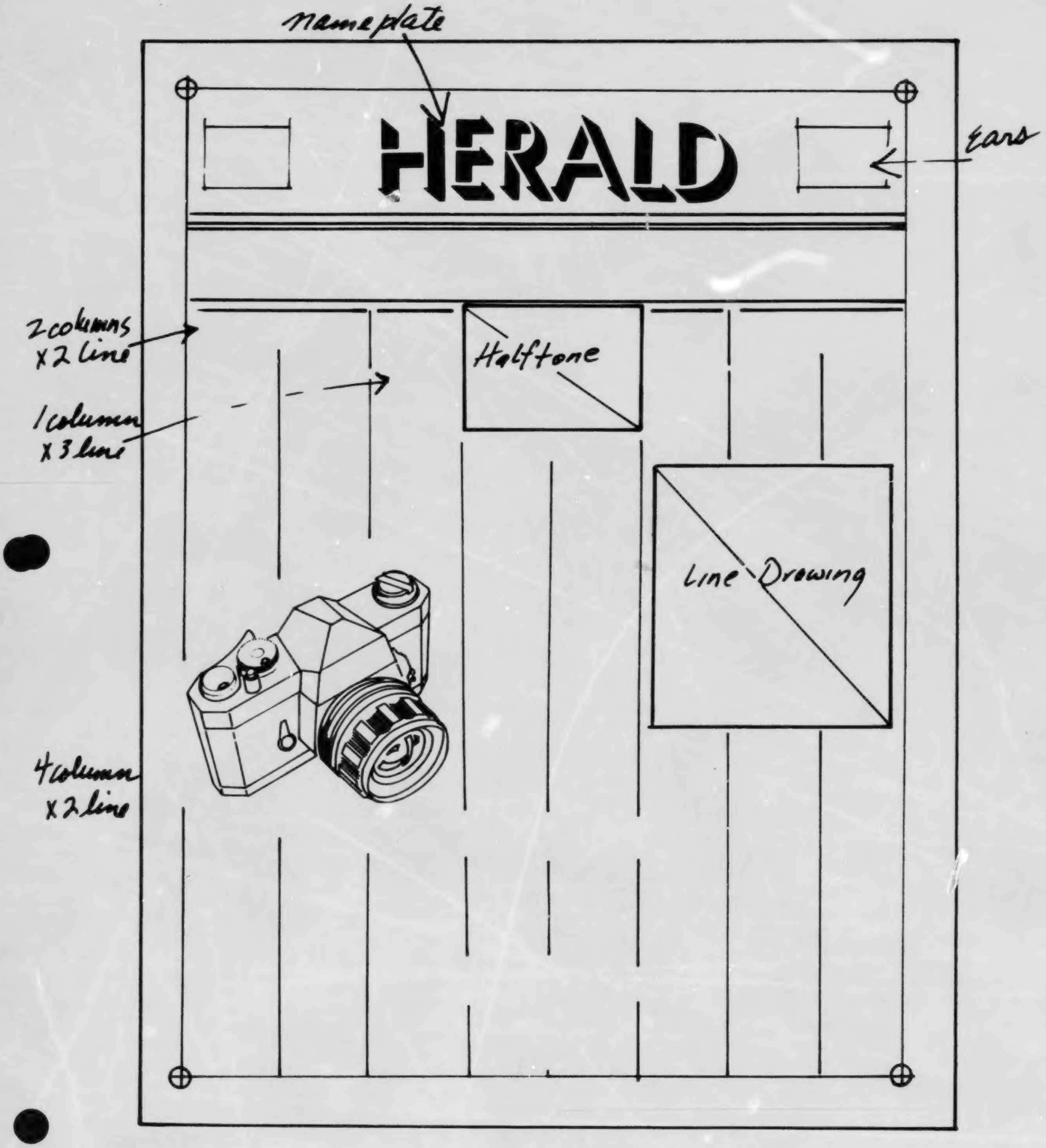


Circle equal lines

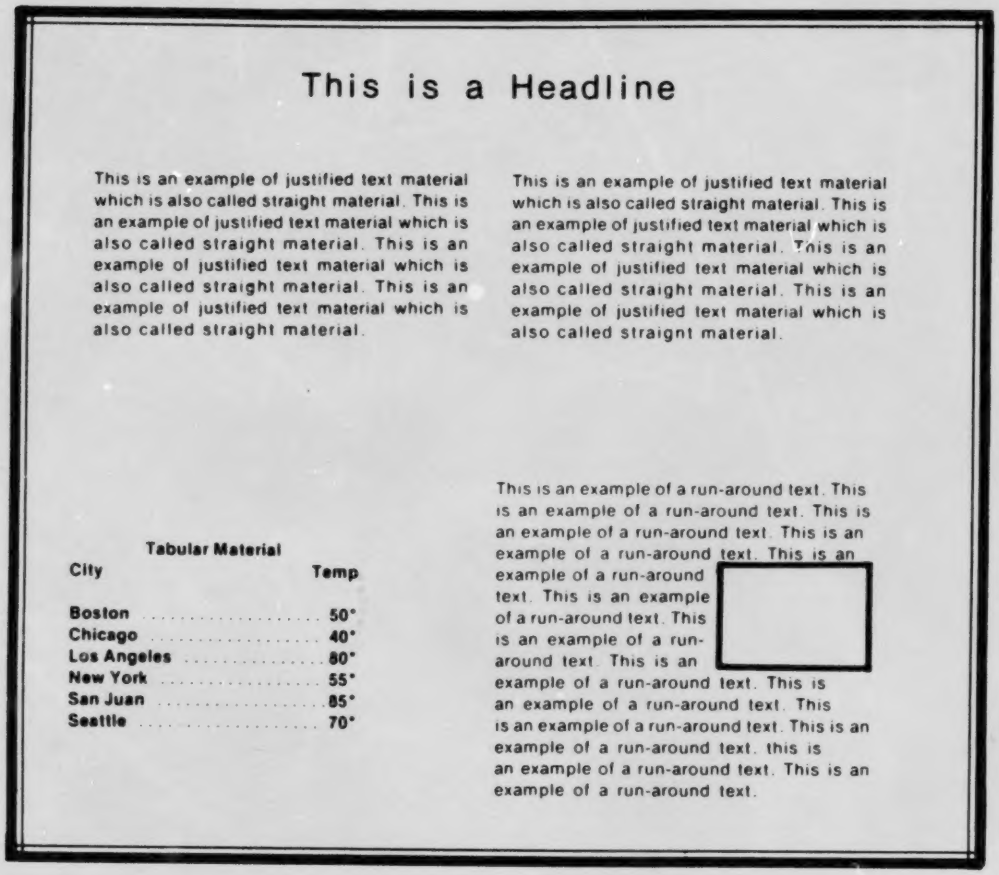


Square
3 different views

PLANNING A LAYOUT


namEplate
HERALD
Ears
2 columns x 2 line
1 column x 3 line
Halftone
Line Drawing
4 column x 2 line

LAYOUT



This is a Headline

This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material.

This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material. This is an example of justified text material which is also called straight material.

Tabular Material

City	**Temp**
Boston	50°
Chicago	40°
Los Angeles	80°
New York	55°
San Juan	85°
Seattle	70°

This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. This is an example of a run-around text. this is an example of a run-around text. This is an example of a run-around text.

This type of layout can be done with an IBM Composer

Data 70
Alternate Gothic 2
Grotesque
Shatter
Clarendon

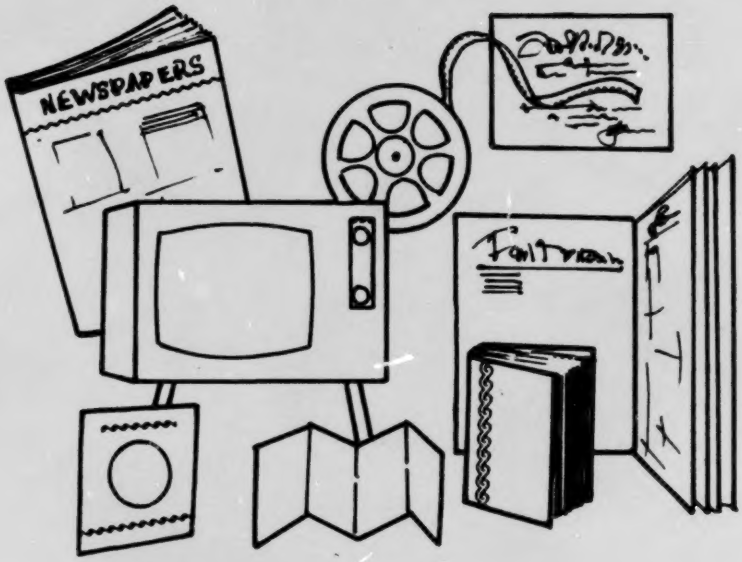
Cable
Antique
Microgramma
Arnold Bocklin
Gill Sans
Standard
Bookman

TYPE STYLE

Caslon Antique
Korinna
NEON
ENGINEERING
Brush Script
Old English
Helvetica

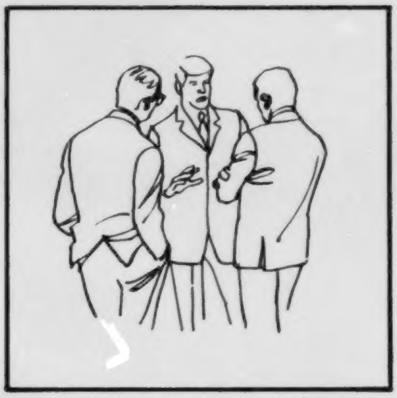
Avant Garde
Tiffany
University Roman
Windsor

TYPOGRAPHY
examples

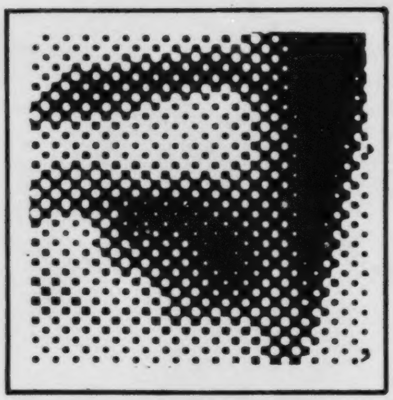


Newspapers
Film
Magazines
Billboards
Road signs
Television
Books
Packaging

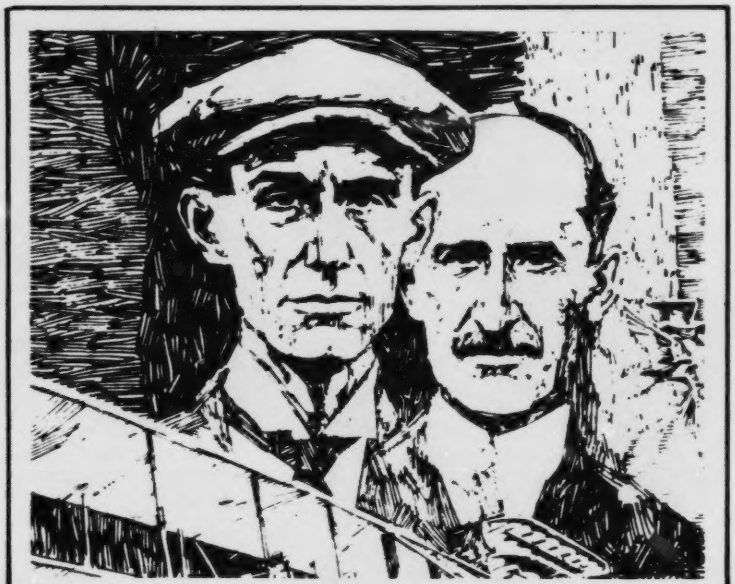
TYPES OF ARTWORK



Line drawing

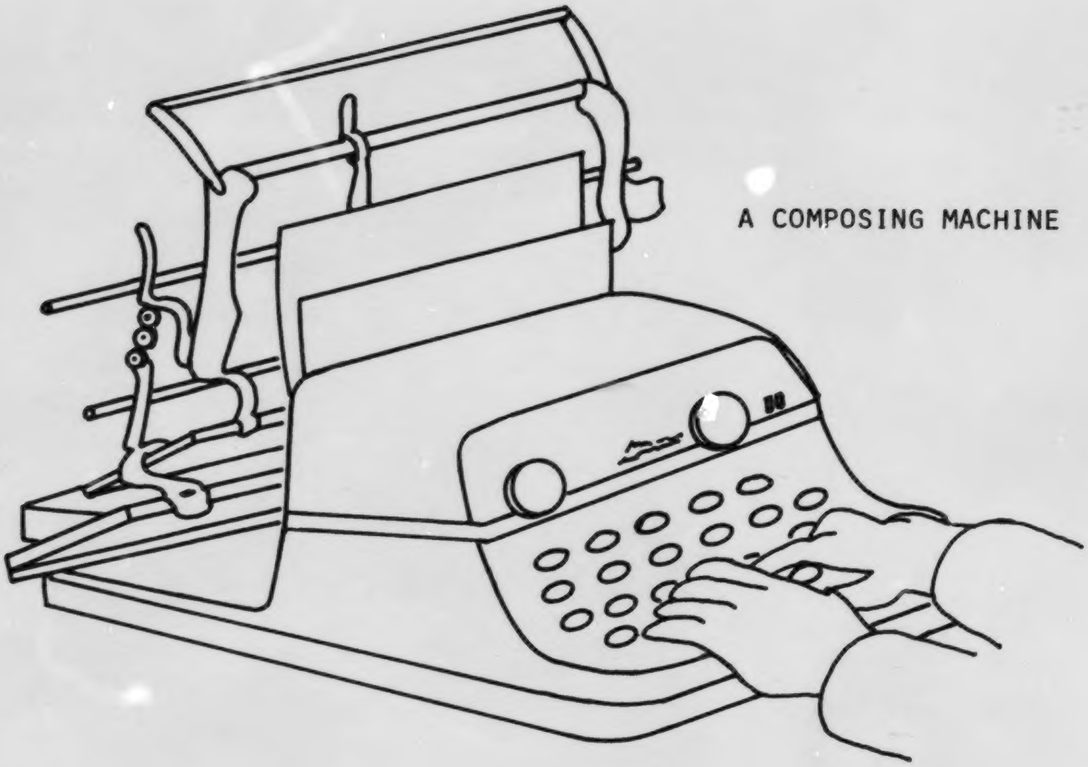


Halftone



Pen and ink drawing

HOT TYPE



A COMPOSING MACHINE

Student Activity #1

PRODUCING A POSTER

Objective:

Student will take the materials and demonstrate the ability to complete a thumbnail sketch, complete a rough drawing, and complete a comprehensive layout.

Materials:

1. Pencil
2. Compass
3. Ruler
4. T-square
5. Paper
6. Triangle
7. Masking tape
8. Marker
9. Pen and ink
10. Brush
11. Paint

Procedures:

Complete Student Activity based on teacher demonstration and teacher supervision, utilizing guidelines explained on Information Sheet #1.

SUGGESTED TEST

Poster Making

1. List steps involved in making a poster.

   a.

   b.

   c.

   d.

   e.

2. Define:

   Thumbnail sketch ______________________________

   Rough layout ______________________________

   Comprehensive layout ______________________________

   Paste up ______________________________

3. What are the factors that determine selection of appropriate printing process?

ANSWERS TO SUGGESTED TEST

1. A. Thumbnail sketch
   B. Rough layout
   C. Comprehensive layout
   D. Composing type
   E. Paste ups

2. Thumbnail sketch--Used mainly to suggest the position of the different parts of the poster. By working broadly and at a small scale, many arrangements can be made quickly.

   Rough layout--Should be actual size and should give specifications for size and kinds of type required and their location. This is a guide for composing type.

   Comprehensive layout--Almost an exact copy of how the printed piece will appear after its completion.

   Paste up--A camera piece of artwork.

3. Design, size, thickness of stock and length of run.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

GENERAL SAFETY

DESCRIPTION OF UNIT

This unit covers the rules for shop and personal safety. The materials in this unit are designed for 3 hours of instruction.

UNIT OBJECTIVE

After completion of this unit the student will be able to recognize, discuss and follow the general and personal safety rules of the shop.

PERFORMANCE OBJECTIVES

After completion of the unit the student will be able to:

1. Discuss the safety rules of the shop.
2. List the rules for personal safety.
3. List the rules for general shop safety.
4. Identify the types of fire extinguishers and be able to use them.

OUTLINE OF CONTENT

I. Safety

Freedom from danger or possible accidents.

II. Accident

Any injury, personal or property happening without cause.

III. First Aid

Temporary care or treatment given to the victim of an accident until professional treatment can be obtained.

IV. Personal Safety Rules

A. Wear clothing appropriate to the job being done.

B. Confine long hair before using equipment.

C. Wear safety glasses in dangerous areas.

D. Remove any loose clothing such as ties, coats, long sleeves when working in the shop.

E. Remove rings or other jewelry when working in the shop.

F. Operate only the machines you are qualified to run.

G. Conduct yourself in a manner conducive to the safety of others.

H. Wash your hands with soap and water after using any chemicals or irritants in the shop.

I. Use hand cleaner, soap and water to remove ink from your hands.

J. Advise your teacher of any accidents.

V. General Shop Safety Rules

A. Keep all machines and tools clean and in good working order.

B. Report any unsafe conditions to the teacher.

C. Be sure all machine safety guards are in place.

D. Turn machines off after using.

E. Unplug any machine before working on them for maintenance or oiling.

F. Know the correct solvent to use in any situation.

G. Clean up spills immediately.

H. Place used, oily rags in a metal safety container.

I. Be sure the shop is ventilated adequately.

J. Protect eyes from the bright exposure lights.

VI. Keeping an Orderly Shop

A. Be sure all machinery is arranged in a safe manner.

B. Put all materials and supplies in their proper places.

C. Keep all tools in their designated, proper place.

D. Use the right tool for the job.

E. Keep working areas clean.

F. Keep floors clean.

G. Make sure all traffic aisles are clear.

VII. Types of Fires

A. Class A--Combustible materials such as wood or oily rags.

B. Class B--Flammable liquids. . .gasoline, oil, grease.

C. Class C--Electrical such as motors, wiring and switches.

VIII. Fire Extinguishers

A. Pressurized water--(operates by squeezing) Used on Class A fires.

B. Soda acid--(operates by turning extinguisher upside down) Used on Class A fires.

C. Carbon dioxide--(operates by squeezing handle) Used on Class B and C fires.

D. Dry chemical--(operates by squeezing mechanism) Used on Class B and C fires.

E. Foam fire extinguisher--(operates by turning extinguisher upside down) Used on Class A and B fires.

TEACHER ACTIVITIES

1. Provide the student with student module.
2. Make transparencies.
3. Discuss unit and objectives.
4. Discuss information sheets and outline of contents.
5. Discuss student activity sheets.
6. Give test.

(NOTE: Have the local fire department come to your shop and give safety and fire demonstrations.)

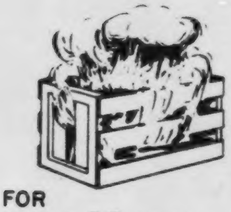
STUDENT ACTIVITIES

1. Read objective sheet.
2. Study information sheets.
3. Complete activity sheets.
4. Take test.

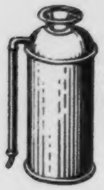
REFERENCES/RESOURCES

1. Information sheets
2. Transparency masters
3. Activity sheets
4. Demonstrations

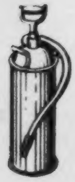
FIRES AND EXTINGUISHERS



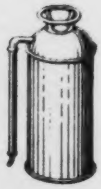
FOR
CLASS "A" FIRES



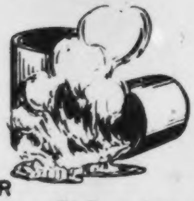
SODA-ACID



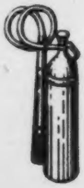
WATER PUMP



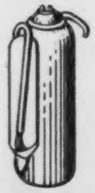
FOAM



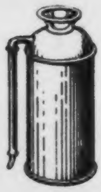
FOR
CLASS "B" FIRES



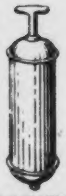
CARBON DIOXIDE



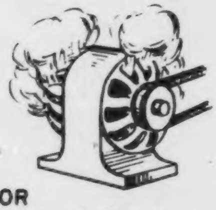
DRY
CHEMICAL



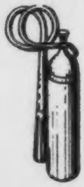
FOAM



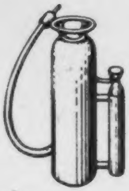
VAPORIZING
LIQUID



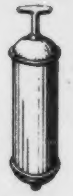
FOR
CLASS "C" FIRES



CARBON DIOXIDE



DRY CHEMICAL



VAPORIZING LIQUID

Student Activity Sheet #1

Define the following:

1. Safety

2. Accident

3. First aid

List ten safety rules of the graphic arts shop:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

List three types of fires:

1.

2.

3.

GA 8.8

List five types of fire extinguishers and describe which type of fire for which each is used:

1.

2.

3.

4.

5.

List the methods of keeping an orderly shop and describe why the shop should be kept orderly.

1.

2.

3.

4.

5.

6.

7.

List the general shop safety rules:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

TENNESSEE INDUSTRIAL ARTS CURRICULUM

COMMUNICATIONS

Instructional Section:

GRAPHIC ARTS

Title of Unit:

PRE-TEST/POST-TEST

Graphic Arts

PRE-TEST/POST-TEST

Matching:

A. graphic arts
B. relief printing
C. intaglio printing
D. planographic printing
E. silk screen printing
F. letterpress
G. wood cut
H. type-high
I. offset lithography
J. block printing
K. linto-cut

L. communication
M. stock
N. registered apprentice
O. thumball apprentice
P. comprehensive layout
Q. printers type
R. linotype machine
S. photoengraved dies
T. slug
U. stereotype
V. flexography

_____ 1. The body height of a piece of type.

_____ 2. A print made in fairly soft wood cut plankwise.

_____ 3. Messages received by the eye.

_____ 4. Printing from a reversed surface.

_____ 5. Used mainly to suggest the position of the different parts of the poster.

_____ 6. A stencil printing process.

_____ 7. Printing process that is well suited for the printing of illustrated materials both photographic and line copy.

_____ 8. Used as a modern substitute for wood for the cutting and making of block prints.

_____ 9. A rubber cast of die or slugs.

_____10. A line of type.

_____11. Chief among these is the printing, publishing and packing industries.

_____12. The design stands about the general level of the plate surface.

_____13. When the wood/linoleum is removed inside and about the design leaving it standing in relief.

_____14. A broad connotation referring to whatever material is to be printed.

_____15. Almost an exact copy of how the printed materials will appear after its completion.

_____16. The design is scratched, engraved or etched into the plate.

_____17. An employee who under an agreement received instruction in a specific occupation for a specified period of time.

_____18. Printing is done from a smooth surface treated chemically or mechanically so that some areas will print and some areas will not print.

_____19. Each letter is cast in its own individual piece of lead by hand.

_____20. Relief printing from rubber plates.

_____21. Will set a line of type on a single piece of lead.

_____22. Permits any black and white art work to be hot stamp printed by etching the artwork onto the die.

Answer True or False

_____23. The earliest form of printing was done from wooden blocks in China about 868 AD.

_____24. The significant breat through in printing occured in 1450 AD when Johann Guttenberg developed the process of printing from movable type.

_____25. Silk screen printing is used to produce treasury notes, stamps and some magazines.

_____26. Gravure (intaglio) is used to produce signs, lamp shades and bottles.

_____27. Hot stamp printing is a relief printing process also known as gold stamping.

_____28. Flexography is a term used to describe relief printing from metal plates.

_____29. Matchbooks are commonly printed by the hot stamping process.

_____30. Paper was commonly used to print on as early as the 15th Century.

_____31. Lettering on a poster should be horizontal, almost never vertical.

_____32. The basic principal (oil and water will not mix) in lithographic printing was discovered by Alois Senefelder in 1798.

_____33. Almost every town in the country has a print shop.

_____34. Apprenticeships for the printing trades usually last 4 to 6 years.

_____35. It is not necessary for apprentices to pass a physical examination.

_____36. Graphic communications is primarily concerned with sound.

_____37. The press used for hot stamping should have one standard heat setting.

_____38. Computers are used to set type for newspapers.

_____39. More than one-half of the people employed in printing are located in 5 states.

_____40. Electrostatic printing is commonly known as Xeroxing.

ANSWER SHEET

PRE-TEST/POST-TEST

1. H
2. G
3. A
4. F
5. O
6. E
7. I
8. K
9. U
10. T
11. L
12. B
13. J
14. M
15. P
16. C
17. N
18. D
19. Q
20. V
21. R
22. S
23. T
24. T
25. F
26. F
27. T
28. F
29. T
30. F
31. T
32. T
33. T
34. T
35. F
36. F
37. F
38. T
39. T
40. T

COMMUNICATIONS

JOB STRUCTURE: PRINTING

JOB TITLE: Photoradio Operator D.O.T. No.: 193 362 010

Major Job Function:

Operates electronic equipment to transmit and receive radio photographs and repairs equipment.

Job Duties:

1. Mounts photographs or printed matter on cylinder and secures with a gripper bar.
2. Turns dials to set frequency controls.
3. Starts equipment that scans material and converts light and dark areas into electrical impulses for transmission.
4. Communicates with receiving operator to give and receive instructions for transmission.
5. Positions negative on cylinder, sets controls, and listen for signals to receive transmission.
6. Develops negatives, prints photographs, and keeps log of transmissions.
7. Maintains and repairs electronic equipment, such as wire circuit, dials and gauges, using schematic diagram, handtools, and test instruments.
8. Reruns transmission when photograph is substandard.

JOB TITLE: Linotype Operator D.O.T. No.: 650 582 010

Major Job Function:

Operates machine to cast complete lines of type from type metal and deposits them in galley in composed form for printing.

Job Duties:

1. Starts type-casting mechanism and adjusts marginal stops and gauge to regulate length and thickness of lines to be cast.
2. Reads copy and presses keys of keyboard to select matrices of letters from magazine which are assembled into words.
3. Moves lever to cast line and deposit it in galley when line is complete.
4. Transfers lines of type, with copy, to composing or bank table for making proof copy.
5. Sets new lines of type to correct errors as indicated on proof-sheet.

JOB TITLE: Photocomposing Machine Operator D.O.T. No.: 650 582 018

Major Job Function:

Sets up and operates photocomposing machine to transfer data from perforated or magnetic tape into print on film or photographic paper, using either of the following methods.

Job Duties:

(I) 1. Loads roll of film or paper in machine magazine.

2. Secures roll of perforated tape on machine reel and threads end of tape through machine feed rollers.
3. Selects type font according to size and face of type specified and positions it on photographic unit.
4. Turns dials to adjust line spacing and light intensity according to size and face of type.
5. Starts machine that automatically prints type onto film or paper according to coded signal on tape.
6. Removes finished copy from magazine for development.

Photocomposing Machine Operator Job Duties (continued):

(II) 1. Places reel of magnetic tape onto feed spindle of phototypesetting unit.

2. Depresses keys to enter command codes, such as size and style of type, width and length of column, and to activate computer to produce phototypesetting film, phototypesetting paper, or copy of tape.

3. Removes and stacks finished copies from photocopy printing unit.

4. Removes printing unit from machine, drains chemical solution, washes unit, and refills unit with specified developing solution.

JOB TITLE: Engraving Press Operator D.O.T. No.: 651 382 010

Major Job Function:

Makes ready and operates press to engrave decorative designs or lettering on announcements, greeting and business cards, letterheads, and related items, following operating procedures outlined on job order.

Job Duties:

1. Installs appropriate die and inking rollers on ram, using wrench.
2. Cuts out and fastens paper template to bed of press to maintain flatness of finished cards or sheets.
3. Inserts and adjusts roll of wiping paper that automatically cleans die between impressions.
4. Thins ink to desired consistency and fills ink fountain.
5. Starts press to obtain proof copy.
6. Examines proof and adjusts press and ink fountain to obtain uniform indentation and color registration.
7. Starts press and feeds cards or sheets to be engraved onto bed of press.

JS GA 4

JOB TITLE: Offset-Press Operator D.O.T. No.: 651 482 010

Major Job Functions:

Makes ready and operates offset printing press to print single and multicolor copy from lithographic plates, examining job order to determine press operating time, quantity to be printed, and stock specifications.

Job Duties:

1. Washes plate to remove protective gum coating.
2. Builds up back of plate with sheets of folio to raise plate to printing level.
3. Installs plate with backing on plate cylinder and locks in position, using handtools.
4. Applies folio to blanket cylinder to build up to diameter of plate cylinder.
5. Fills ink fountains.
6. Adjusts space between blanket and impression cylinder according to thickness of paper stock.
7. Adjusts controls to regulate moisture delivery to plate cylinder.
8. Operates press to secure proof copy.
9. Examines proof and adjusts press controls to obtain specific color registration.
10. Starts press and completes production run.
11. Removes and cleans plate and cylinders at end of run.

JOB TITLE: Embosser D.O.T. No.: 659 382 010

Major Job Function:

Sets up and operates machine to emboss gilt or blind (without goldleaf) lettering and design on book covers, following specifications.

Job Duties:

1. Glues embossing plate to copper backing plate and installs it in hot plate of machine.
2. Cuts piece of cardboard to approximate size of plate and places it on machine bed under plate.
3. Starts machine to lower ram and impress cardboard.
4. Cuts surface of cardboard around impression, leaving design or letters raised to increase machine pressure at contact points, using knife, compass, and square, and glues it to bed under plate, adjusting bed so impression and plate are in alignment.
5. Closes switch to heat plate.
6. Sets guides to hold cover in position, and adjusts table height to obtain correct depth of impression.
7. Places cover, with prelaid goldleaf in position, against guides on machine bed and starts machine that lowers ram and stamps goldleaf design or lettering on cover.
8. Removes and stacks embossed covers.
9. Stamps blind lettering or designs on covers in like manner.

JOB TITLE: Telephone Directory Distributor D.O.T. No.: 906 683 018

Major Job Function:

Drives automobile or truck to transport telephone directories from central storage facilities to distribution area.

Job Duties:

1. Loads vehicle with assigned number of books and drives to distribution district, parking vehicle in convenient or centralized location.
2. Distributes books to Telephone Directory Deliverers for delivery to residences and business establishments indicated on address lists.

JS GA 6

JOB TITLE: Photoengraving Etcher D.O.T. No.: 971 381 014

Major Job Function:

Etches metal photographic plates to produce photoengraved printing plates, using Etching Machines, handtools, and chemicals.

Job Duties:

1. Mixes caustic or acid solutions according to type metal plate being etched.
2. Brushes protective solution on back and edges of metal plate to protect plate during etching process.
3. Brushes protective power over photographic emulsion on plate to protect printing design.
4. Bakes plate to adhere power to design, using gas heating plate.
5. Mounts plate in etching machine and starts machine that sprays acid or caustic solution against plate to etch areas not protected by resist solution or power.
6. Removes and measures plate to determine depth or etching, using depth gauge, and remounts plate in machine when etching has not attained specified depth.
7. Washes and scrubs etched plates to remove resist solutions and photographic emulsion, using brush and caustic.
8. Dries plates, using chamois cloth.
9. Matches colors with original artwork of multicolor photographic plates to produce balanced color valves, applying knowledge of photographic printing process.

JOB TITLE: Photoengraver D.O.T. No.: 971 381 022

Major Job Function:

Photographs copy, develops negatives, and prepares photosensitizine metal plates, such as copper, zinc, aluminum, and magnesium for use in printing, using photography and developing equipment and engravers' hand tools.

Job Duties:

1. Positions copy on copy board of darkroom camera and exposes film to copy.
2. Fastens scoured metal plate to whirling machine table or suspension hooks, pours photosensitizine solution on plate and starts machine which rotates plate to distribute and dry solution evenly over plate surface.
3. Exposes negative and plate to bright light in vacuum type printing frame to transfer image onto plate.
4. Rolls ink onto exposed plate and washes unexposed and unfixed emulsion from plate, using running water and cotton pad to expose bare metal.
5. Places developed plate in acid bath or etching machine to erode unprotected metal to specified depth.
6. Mounts etched plates on wood blocks, using hammer and nails or on metal base, using thermosetting adhesive to raise printing surface type to specified height.
7. Removes excess metal from non-printing areas of cut, using routing machine.
8. Cuts mortises in mounted plates, using power drill and jigsaw, for insertion of type or other cuts.
9. Modifies and repairs finished plates, using engraver's hand tools, etching brush, and acid.

JOB TITLE: Photoengraving Finisher D.O.T. No.: 971 381 030

Major Job Function:

Blocks out, re-etches, or intensifies designs to refine or repair copper, zinc, aluminum, and magnesium photoengraved printing plates according to copy and specifications, using artist's brushes and hand engraving and burnishing tools.

Job Duties:

1. Applies chalk to engraved surface and examines cut under magnifying glass to detect damaged halftone dots and evaluate quality of etching against copy.

Photoengraving Finisher Job Duties (continued):

2. Outlines images, cuts border, blocks out backgrounds, and raises halftone dots, using engraving tools.

3. Burnishes high halftone dots to correct defects in printing quality and contrast of cut, using burnishing tools.

4. Repairs breaks in type, using hand tools.

JOB TITLE: Photoengraving Proofer D.O.T. No.: 971 381 038

Major Job Function:

Proves printing quality and register of photoengraved printing plates, using hand or power driven flatbed or cylinder press, and prepares data sheet on color matching or ink modification to improve printing quality and register according to copy or customer specifications.

Job Duties:

1. Clamps plates to press, applies ink to rollers, and positions guides, grippers, and fingers to guide paper through press.

2. Wraps packing sheets and tympan around cylinder to form cushion.

3. Cuts and pastes overlays under tympan sheet to increase impression of low areas.

4. Depresses pedal to open grippers, inserts blank sheet, and turns crank or starts motor to print set of proofs for progressive proof book for both black and white and color plates.

5. Prepares data on color matching and ink modification to guide pressman.

6. Examines proofs to determine printing quality of dots and lines, using magnifier, and marks corrections, such as re-etching and additional finishing.

JS GA 9

JOB TITLE: Photoengraving Photographer D.O.T. No.: 971 382 014

Major Job Function:

Sets up and operates camera to photograph drawings, sketches, or other material to produce negatives for transfer to printing plates, rollers, or printed circuit boards.

Job Duties:

1. Mounts copy on holder, aligning center line on copy with center line on holder.

   Studies copy and order sheet to determine photographic technique required to transfer desired effect onto film, according to plat or roller dimensions, type of design, colors in design, and engraving requirements.

3. Computes camera settings required to reproduce sketch to specified scale according to dimensions of printing plates or rollers
4. Focuses camera, compensating for difference in size and distortions in copy.
5. Measures opening in back of camera to verify settings, using steel tape.
6. Positions film on vacuum board, closes board against back of camera, and locks board in position.
7. Arranges arc lamps for even distribution of light and exposes film for specified length of time.
8. Removes exposed film from camera and develops film in series of developing, rinsing, and fixing baths, or using automatic film processing equipment.
9. Compares developed film with design to determine whether desired effect has been reproduced.
10. Hangs film on line to dry.
11. When producing negatives for half tone printing, inserts screen in front of film to reduce copy to dots for reproduction.

JS GA 10

JOB TITLE: Scanner Operator D.O.T. No.: 972 282 010

Major Job Function:

Operates electronic color scanner to produce color separated positive or negative films for use in producing printing plates.

Job Duties:

1. Examines copy to be reproduced for possible reproduction problems and plans work to include optimum corrections.
2. Evaluates density of colored and black areas, using knowledge of light and color and densitometer.
3. Sets scanner dials to indicate specific color density, size, and type of film to be produced, and starts machine to automatically produce separate positive or negative films for each primary color and black contained in original copy.
4. Examines processed film to insure consistency of quality and places complete positive or negative and original copy in envelope for return to customer.

JOB TITLE: Lithographic Plate-Maker D.O.T. No.: 972 381 010

Major Job Function:

Transfers positive or negative images to metal plates to produce offset photolithographic printing plates, according to oral or written instructions, using liquid formulas, photocomposing machine, plate whirler, layout table, and measuring instruments.

Job Duties:

1. Mixes chemicals, according to standard formulas and type metal used, to prepare platemaking solutions, such as counter-etch, photosensitive coatings, developers, gum solutions, lacquers, developing inks, and desensitizing etches, using graduates, beakers, and stirrers.
2. Washes grained metal plate with running water or acid solution to remove dirt and grease.
3. Pours counter etching solution over grained surface and spreads solution, using cotton pad to prepare smooth surface on plate.

Lithographic Plate-Maker Job Duties (continued):

4. Clamps plate on whirler disk, starts machine, and pours sensitizing solution onto center of whirling plate to coat surface evenly.

5. Adjusts controls to regulate whirling speed, drying temperature, and humidity.

6. Positions plate under arc lamp of vacuum frame or photocomposing machine and exposes plate to positive or negative image under lamp to transfer image to plate.

7. Sets exposure time on vacuum frame or photocomposing machine according to density of negative or positive, sensitivity of coating, temperature, humidity, and thickness of coating.

8. Washes exposed plate in water and applies lacquers, developing inks, desensitizing etches, gum solutions, and asphaltum to develop image on plate according to process specifications and metal use.

JOB TITLE: Lithographic Photographer D.O.T. No.: 972 382 014

Major Job Function:

Sets up and operates camera to photograph illustrations and printed material and produce film or glass negatives or positives used in the preparation of lithographic printing plates.

Job Duties:

1. Mounts material to be photographed on copy board and focuses camera to enlarge or reduce size of object in photograph.

2. Selects and places screen over negative or positive to break up shadings in object for halftone printing.

3. Places color filters over film to produce four-color separation, halftone separation, and process prints for multicolor printing.

4. Focuses lens, adjusts lights, and exposes film to copy for specified period of time.

5. Immerses film in series of chemical baths to develop image on film or mounts film in machine that automatically develops film.

6. Hangs developed film on rack to dry.

JS GA 12

JOB TITLE: Plate Grainer D.O.T. No.: 972 682 010

Major Job Function:

Operates plate graining machine to roughen faces of flexible sheets of zinc or aluminum metal for use in offset-photolithographic printing.

Job Duties:

1. Operates power shear to cut sheets of aluminum or zinc to size, and clamps them to bed of graining machine tub.
2. Operates hydraulic lifting and ticting mechanism attached to machine to load and unload machine with specified amount of steel or wooden balls, water, and abrasive.
3. Washes sediment from plates with water hose at end of graining cycle and places on conveyor for further washing under water sets and drying under heating unit.
4. Examines each plate with magnifier at inspection table for uniformity, size, and structure of grain.
5. Stacks plates in shipping crate.
6. Rolls out and hammers used plates to remove gripper marks, dents, and bent corners.
7. Lubricates machine and replaces worn bearings.

JOB TITLE: Compositor D.O.T. No.: 973 381 010

Major Job Function:

Sets type by hand and machine, and assembles type and cuts in a galley, for printing articles, headings, and other printed matter, determining type size, style, and compositional pattern from work order.

Job Duties:

1. Measures copy with line gauge to determine length of line.
2. Sets composing stick to line length indicated on line gauge.

Compositor Job Duties (continued):

3. Selects type from type case and sets it in compositional sequence reading from copy.

4. Inserts spacers between words or units to balance and justify lines.

5. Transfers type from stick to galley when setup is complete.

6. Inserts leads, slugs, or lines of quads between lines to adjust length of setup, using proof press.

7. examines proof for errors, corrects setup, and forwards it to imposing stone or bank.

8. Cleans type after use and distributes it to specified boxes in type case.

JOB TITLE: Printer D.O.T. No.: 973 381 018

Major Job Function:

Sets type according to copy and operates cylinder or automatic platen press to print complete job order.

Job Duties:

1. Selects type from type case and inserts in printer's stick to reproduce material in copy.

2. Inserts spacers between words and leads between lines.

3. Slides type from stick into galley.

4. Removes assembled type from galley and places type on composing stone.

5. Places chase over type, inserts quoins and locks chase to hold type.

6. Lays form (type in locked chase) on bed of proof press, ink type, fastens sheet of paper to press roller, and pulls roller over form to make proof copy.

7. Reads proof for errors and clarity of impression.

Printer Job Duties (continued):

8. Corrects errors by resetting type and improves impression by tapping face of type with hammer.
9. Positions form on bed of press and tightens clamps, using wrench.
10. Fills ink fountain and moves lever to adjust flow of ink.
11. Sets feed guides according to size and thickness of paper.
12. Runs proof sheet through press and examines sheet for clarify of impression.
13. Pushes button to start press, examines printed sheets, and adjust press when printing is defective.
14. Cleans ink rollers at end of run.

JOB TITLE: Engraver D.O.T. No.: 979 381 010

Major Job Function:

Engraves lettering or designs in copper or steel printing plates, using pantograph engraving machine.

Job Duties:

1. Rubs blank plate with emery or charcoal and oil to polish surface.
2. Clamps blank plate in position under damond cutting point and master plate under tracing point of pantograph.
3. Starts electric motor that revolves cutting point and lowers engraving control bar, simultaneously moving bar sideways until tracing point enters desired figure on master plate.
4. Moves bar so that tracing point follows figure on master plate, reproducing figure on blank plate.
5. Loosens thumbscrews and changes position of pantograph bar to reproduce figures larger or smaller than those on master plate.
6. May be designated according to type of plate used as copper plate engraver and steel plate engraver.

JOB TITLE: Graphic Arts Technician D.O.T. No.: 979 382 018

Major Job Function:

Reproduces and assembles graphic arts materials performing any combination of the following tasks.

Job Duties:

1. Operates machine to type master copies, such as stencils, tracings, direct plates, and photo-offsets in preparation for line copy reproduction.
2. Operates offset-duplicating machine to reproduce single or multicolor copies of line, drawings, graphs, or similar materials.
3. Sets up and operates various type cameras to produce plastic or paper plates, and negatives for later use in preparation of aluminum plates for reproduction in offset lithographic process.
4. Positions material to be photographed, focuses lens, adjusts light, and exposes film to copy for specified period of time.
5. Mixes chemical solutions according to formula; and immerses film in solutions to develop negatives.
6. Positions developed negative under masking sheet in lighted box that allows viewer to see negative through masking sheet.
7. Strips masking sheet according to size and/or shape of image to be printed.
8. Opaques errors and blemishes on negative, using brush and chemicals.
9. Places finished masked negative on aluminum plate, and exposes plate to negative under arc lamp to transfer image to plate, using vacuum frame.
10. Applies chemicals to plate to develop transferred image to be printed.
11. Tends machines that assemble pages of printed material in numerical sequence.
12. Cuts, forms, sews, and glues components to form books, using stapling, drilling, and binding machines.
13. Maintains machinery and equipment in operating condition.

JS GA 16

JOB TITLE: Screen Printer D.O.T. No.: 979 684 030

Major Job Function:

Prints lettering and designs on objects such as posters, glass, and texting using screen and squeegee.

Job Duties:

1. Sets register guides along edge of printing table at intervals specified for pattern repeat.
2. Pours color paste onto screen and position screen against guides over object.
3. Draws squeegee across screen to press color paste through open portion of screen and print design.
4. Repeats process with different screen for each color in design.
5. Washes screen with water or solvent to remove color paste.